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The President and Latin American Relations

MINING has become so international in character that friendly relations between the various countries of the world are of great importance to the industry. It is for the good of mining engineers in the United States, and for most of the financial interests that they represent, that difficulties with Mexico be smoothed out and that the friendship of other Latin American countries be cultivated and retained. Rights and privileges are more easily gained and safeguarded through friendship than by force. It is highly agreeable therefore, to be able to speak commendably of President Coolidge's remarks on foreign affairs that were broadcast to so large an audience last week. The Administration at Washington has evidently adopted a conciliatory attitude quite in contrast with some of the feelings that were expressed too forcibly not so many months ago. The Mexican oil difficulty has not been cleared up, of course, but there is a much better prospect of fair dealing from the Mexican Government and Supreme Court now that some of the pugnacity of the American attitude has been removed. President Coolidge has become better acquainted with the Mexican Ambassador, and has not depended upon the State Department for all of his information; perhaps even Secretary Kellogg himself has obtained a more complete understanding of the difficulties. Mexican gestures have not been altogether friendly, nor have American demands apparently been altogether well founded; there is ample reason for each side to step down gracefully. Friendly contact, rather than ultimatums is desirable as a means of attaining the objects sought.

In Nicaragua, it is to be hoped that an amicable solution of the difficulties may be arrived at through the study being given the situation by the President's emissary, Henry L. Stimson. In that country, the United States has a $3,000,000 interest in a canal route, as well as commercial interests, but it is extremely doubtful if the best way to protect these interests is to give active support to a government that does not seem to be endorsed by a majority of the native population. Possibly an election can be arranged under the auspices of a commission neutral to both the Diaz and Sacasa factions; this seems to the outsider a reasonable method of quieting the rebellion and restoring order. The whole Nicaraguan affair has been most unfortunate, particularly because of the effect that it has had on the attitude of other Latin American countries toward the United States. These countries are quick to sense any imperialistic tendency that the State Department may show, and they deeply resent it. One mistaken gesture will offset a dozen good-will airship flights. The American people are anything but imperialistic at heart and President Coolidge, as their spokesman, sounded a true note in disclaiming any such tendency or desire.

Scientific Management Underground

IN THE ISSUE of April 30 appeared a constructive article by G. Townsend Harley on "Time-Study Methods for Mining Operation." Mr. Harley says that "Campaigns for improved management methods have not yet been sold to the general run of mine managers and in a majority of cases the close relationship of profits to management is not clearly recognized or understood." Many will decline to acquiesce to this statement without some qualification. It is true that the mining industry has been backward in introducing, in underground operations, the "efficiency expert" typified by the stop-watch, the busy pencil, and reams of records. The reasons have been various. For one thing, many of the operations in mining do not lend themselves readily to standardization. The same precise set of conditions is not found repeatedly. The judgment and skill of the individual miner as he goes about his work is a more important factor than is that of the employee in many other occupations. A man may work exceptionally hard one day and fail to make a "showing"; the next day the breaks may be with him and he will seem to have accomplished five times as much, though his expenditure of effort may have been less.

Another reason has been the attitude of the underground worker. The miner of yesterday was inclined to be a temperamental individual who did not take kindly to having a "stop-watch artist" trying to figure out the best way to do his work. However, conditions are changing. The old-time miner who "knew ground," who put in his own timber, and who accomplished most when he was bossed the least has already disappeared or is rapidly disappearing. His place has been taken by an individual who may be described better as an underground laborer than as a miner. Coincidentally has come a change in methods of mining. Deposits of lower average grade are exploited. Operations are on a larger scale. Caving, shrinking, rilling predominate—cheap methods where a minimum of timber is used and where little or no selection is possible. These savor of mass production; the individuality of the worker is submerged; standardization becomes possible and the way is open for scientific management. Another factor is the growing need for economizing on labor consequent to the introduction of higher wage scales. In more than one instance the alternative to a thorough reorganization of operations has been shutting down the mine. In this extremity the efficiency man was given his chance, and frequently he has made good.

Efficiency engineering suffered from too much advertising a few years ago; it became something of a joke. If, however, it is viewed in a common-sense light as a process of determining as accurately as possible the way to accomplish any given operation or series of operations with a minimum expenditure of time,

energy, and material—if viewed in this way it has a practical value that can be measured definitely. Scientific management sounds rather imposing; in reality it is nothing but intelligent management, whether it be in the office, the machine shop, or underground.

The White House Roof

THE White House is getting a new roof, and while the old one, built in 1814, is being replaced, President Coolidge has been obliged to move out to escape the April showers. What, the mining industry may ask, is the new covering to be—copper, zinc, slate, asbestos, or something else which the industry had no hand in producing? The interesting story of this new roof, as told in *Construction Methods*, explains that it is to be of arched tile surmounted by unfading green slate, so the mining if not the smelting industry may point to it with pardonable pride. The construction engineer has several excellent roofing materials to choose from today that he did not have a century ago; he can select one that will be as nearly permanent as is anything in this mutable world of ours.

Exchanging Ray Shares

PRESUMABLY most of the holders of shares in the Ray Consolidated Copper Co. who have not exchanged them for Nevada Consolidated debentures are merely inadvertent. Changes of address perhaps have prevented them from getting the notices sent out by the company. Some of the few—more than 95 per cent of the stock has already been exchanged—may be purposely refraining from sending in their stock because they see Ray shares quoted at a slightly higher figure than those of Nevada Consolidated. They are suffering under misapprehension. If the double exchange is effected, the cash adjustments specified more than make up the difference in current market prices.

The transaction by which the two companies were merged provided for the transfer of the mining properties and other physical assets of the Ray company to Nevada in exchange for $46,157,685 in Nevada's 5 per cent debentures, which are convertible into Nevada Consolidated stock. The only assets of the Ray company today are such of these debentures as have not been used to redeem Ray stock; and the only source of income of the Ray company is the interest at 5 per cent accruing from these bonds. The Ray company is to be dissolved soon, and the expenses of liquidation must be paid from the assets in hand, so that those who fail to exchange their Ray shares for debentures will bear this cost. The incentive to convert the debentures into Nevada stock is a cash payment of 25c. per share, if conversion is made on or before July 1, 1927; and the receipt of dividends at the rate of $1.50 per share instead of interest at 5 per cent.

For a variety of reasons an individual conceivably might prefer to own debenture bonds rather than Nevada shares, but no good reason appears for declining to exchange the Ray stock. In connection with several mine consolidations or mergers in the past, recalcitrant minority shareholders have caused the companies concerned much trouble and expense; and at times have been able to turn a profit for themselves by dog-in-the-manger tactics. In the present instance there evidently is no chance of doing either.

Hand-Held Pneumatic Rock Drills in South Africa

IN A RECENT report H. R. Hill, consulting engineer for the Union Corporation, Ltd., reviewing the Witwatersrand gold mines for 1926, states that "Unceasing efforts are being directed to the problem of preventing by higher efficiency, the upward tendency in costs due to the increasing difficulties of mining, such as greater depths of working, the rising temperatures of a moisture-saturated atmosphere underground, the provision of elaborate systems of ventilation and complete reticulation of water-service pipes throughout the length and breadth of the mines, and the necessity for a very much greater measure of support for the underground workings owing to the enormous area excavated." In 1926 this area was estimated at over 1,700 acres, from which 29,485,572 tons of ore was produced, or at the rate of 17,344 tons per acre, the estimated yield being 0.398 tons per square foot. The assay value of the ore was $6.72 per ton, working costs were $4.61, and dividends $1.32 per ton. Expressed in terms of gold produced, working costs were $14.14 per ounce of gold, and dividends $4.05.

The record achieved by the mine managements and engineering staffs is extraordinary in view of the conditions under which the mine operation is conducted. Practically every element involved in deeper mining contributes toward increased cost; and an operating surplus can be maintained only by increased efficiency, which places a severe requirement upon the entire personnel.

Probably one of the most important factors in the present profitable operation of these mines is the modern hand-held pneumatic rock drill. The number of these drills in use was 4,619 in 1926 and the tonnage broken per drill was at the rate of 6,489 tons per annum, compared with 5,852 tons in 1925 and 2,784 in 1921.

Given a static condition in money outgo, increased performance cuts down unit costs and increases output, thereby augmenting gross income. Assuming an adequate amount of developed ore, the important factors governing output are the man who holds the drill, the kind of drill and drill steel, and the quality of drill sharpening. Obviously all other mine functions must be systematically co-ordinated, but maintenance of output begins at the ore faces. Training in the handling of the drill and intelligent supervision are two potent factors in increasing drilling efficiency; it is chiefly in this direction that still lower unit costs are going to be obtained or the tendency to increased operating costs resulting from deeper mining compensated.

Australia's Copper Industry Asks for Subsidy

COPPER MINING is moribund in Australia. Its deplorable condition is commented on in a leader in a recent issue of *The Mining Journal*, of London, which attributes the difficulties to the exacting demands and uneconomic policies of the labor organizations. In this commonwealth, it must be remembered, organized labor has asumed political control to a greater degree than in any other country with the possible exception of Soviet Russia; wage scales and labor conditions have been promulgated that have been too burdensome for most of the mining companies, and a protective tariff has been adopted that has made the cost

of necessary supplies and equipment unduly high for a company marketing a product that must be sold in a world market. So, many well-known mining companies have found it better to curtail or suspend operations, among them being Wallaroo and Moonta, Great Cobar, the Cloncurry properties, Chillagoe and the Etheridge, and Mount Morgan. Only Mount Lyell remains among the considerable producers of the past, and conditions are none too bright for that company, as is indicated by its appeal to the Commonwealth Tariff Board for a bounty on copper. Two wrongs, however, do not make a right, and this would not be a happy solution. It is much the same way out of a difficulty that was in the minds of the sponsors of the McNary-Haugen farm-relief bill, recently vetoed by President Coolidge on such excellent economic grounds.

Mount Lyell, the most enduring of the Australasian copper producers, is favored by what would be considered a rich ore in America, 6 per cent, but suffers from the comparatively small scale of operations—about 350 tons a day, by its distance from much of its market, and, as mentioned before, from local economic conditions. Its mining and metallurgical practice would appear sound, but its costs are high. In the last annual report, for instance, mining charges are given as the equivalent of $5.50 per ton mined; concentration, $3.55 per ton concentrated; smelting to matte, $7.90 per ton ore-bearing charge smelted; and bessemerizing, given separately from smelting, as $8.85 per ton of blister produced. Maintenance, management, repairs, and freight swell the total considerably.

Where conditions are conducive to low costs, the small copper producer is still making money, even with copper at its present level, but the tendency in copper mining, particularly in districts far removed from copper-consuming centers, is toward large-scale operation by companies that are amply financed and can afford the most efficient equipment.

The Flood

THE flood—not that of Noah's time but of our time—is perhaps not so overwhelming, but equally disastrous to the flooded areas. On page 762 there is published an article just released by the Government which points out that flood warnings were issued by federal agencies well in advance of the present catastrophe. In fact, it is stated that the Department of Agriculture issued flood warnings constantly from October on through the winter in various localities, based on observations of rainfall and river stages, as one river system after another became affected by the long-continued rains. The present great Mississippi flood was not unheralded—there is not the least doubt of that. Many have taken advantage of the warnings, others have not; certainly many municipalities have not, and perhaps the federal government may be placed to a certain extent in the same category. Millions of dollars are now being raised to aid the sufferers in the inundated districts; millions also will be spent in engineering measures to control the physical features of the situation. Mining, along with other industries in the areas involved, is sustaining heavy losses due to enforced curtailment of operations and property damage. What portion of these losses in human life, property, and national wealth would have been saved if proper and adequate precautionary measures had been taken to cope with the flood conditions?

By the Way

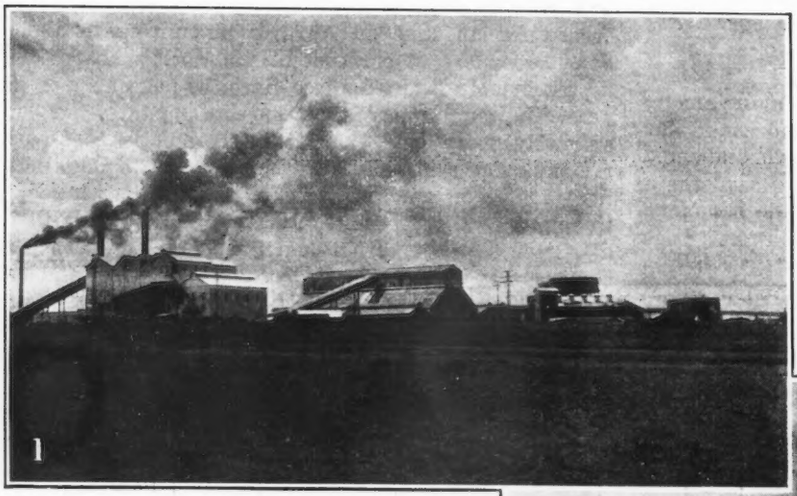
ACCORDING to a United States Treasury report, gold holdings of the United States reached a new record for all time on April 1, amounting to almost $4,600,000,000—44 per cent of the world's hoard—and representing a large increase since the beginning of the year. It would appear that the United States has considerably more gold than it needs and is constantly accumulating still more. Economists and bankers have not yet hit on an acceptable means of diverting gold to countries that need it. Perhaps the subject will be discussed at the International Economic Conference at Geneva this month, at which the *E. & M. J.* and the other McGraw-Hill papers will have a staff representative.

ONE IS prone to forget what a mass of valuable scientific information is published by governmental agencies. The United States Government, for instance, is said to be the largest publisher of scientific works in the world. In this issue appears a valuable article prepared by a member of the staff of the Canadian Department of Mines, which will interest flotation operators all over the world, but which would have been seen by only a few in its original mimeographed form. The theory of flotation has not yet been satisfactorily worked out in all of its phases; empirical methods of testing still prevail, but it is by study of these empirical methods, and their application to ores of varying types, that metallurgists can improve their practice.

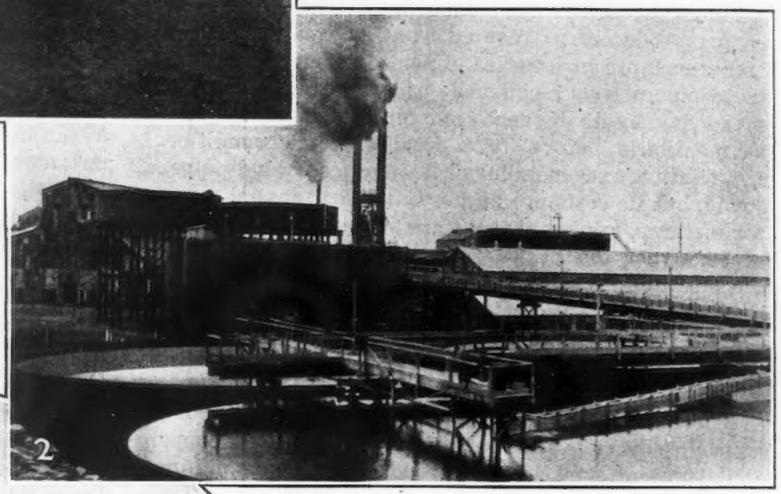
THE mining industry is indebted to the Mines Department of the Mexican Government for defining explicitly the sort of wage necessary to keep a typical family in "a complete state of penury," without "reasonable compensation" and "in comfort," as set forth in detail by Alberto Terrones Benitez on page 763 of this issue. Volumes have been written on the "living wage," but a clear statement on the subject from Mexican authorities is welcome and indicative of intelligent thought in that land on an important economic matter.

THE Wall Street Journal is authority for the statement that Greene Cananea has "made some remarkable discoveries of copper deposits, said to run over 15 per cent to the ton." Wonder what per cent that would be per carload? * * * And a mining broker's circular says that up in the Rouyn district of Canada, at the Duprat mine, "the drills penetrated twenty feet of disseminated sulphide geology." There seems to be quite a bit of this kind of geology in that district; at the Horne mine, however, there is a good block of solid chalcopyrite geology. * * * Foreign publications seem to have as much trouble with English names as we would with Russian or Chinese. Thus the *Giornale di Bibliografia Tecnica Internazionale*, published in Mussolini's realm, mentions the following distinguished members of the editorial staff of the *E. & M. J.*: I. E. Spurr, T. A. Bukard, and Georg I. Joury. * * * Evidence of how a compositor, by using a lower-case letter instead of a capital, can alter the whole meaning of a sentence is afforded by the report in a recent issue of *The American Metal Market* to the effect that "according to a report from Butte, Montana, the diamond mine of Anaconda Copper Mining Co. . . . has resumed work." There are many diamonds in Montana, but they have traveled a long way by express.

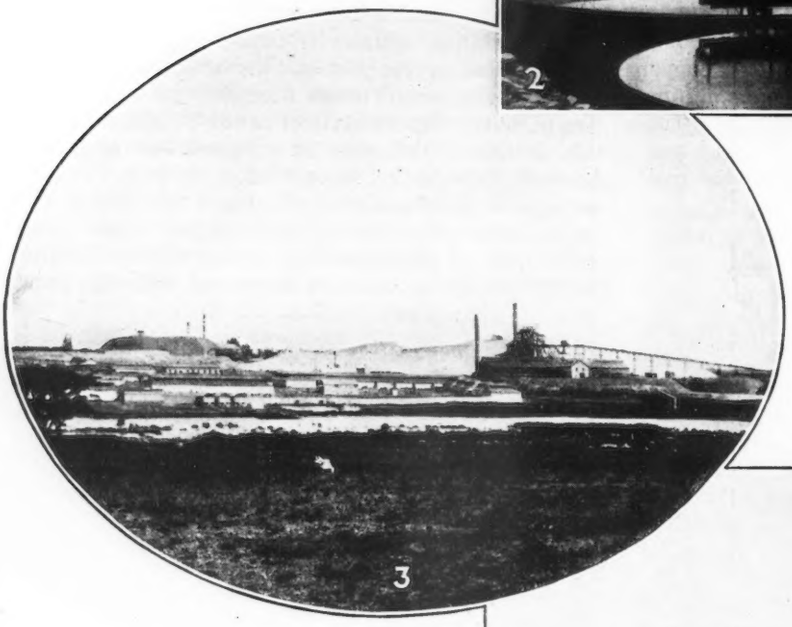
Gold Mines of Interest on the Rand



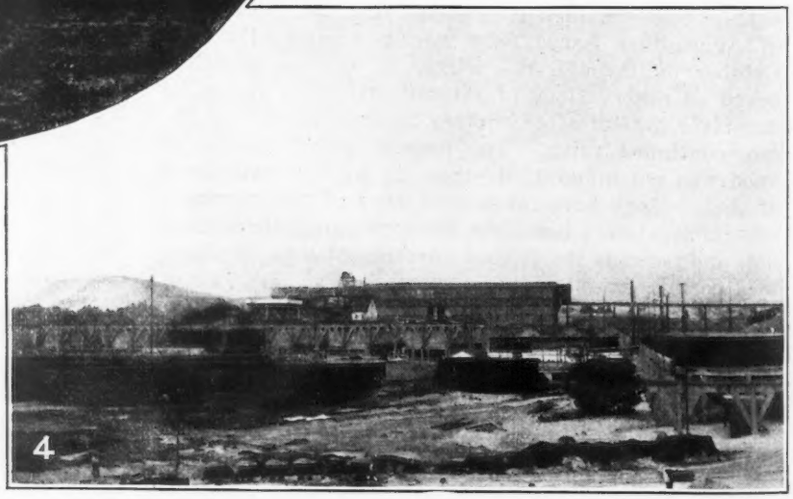
1. General view of Modderfontein East's crushing plant and mill—the newest reduction works in the field



2. Cyaniding section of Modderfontein East plant, from a closer view



3. New Modderfontein's West shaft and reduction plant



4. The City Deep reduction plant

Photos by courtesy of F. Wartenweiler, Johannesburg

Selective Flotation

Effect of Various Reagents—Test Results on Complex Ores

By C. S. Parsons

Engineer, Canadian Department of Mines, Ottawa
From a mimeographed bulletin of the Canadian Department of Mines, Mines Branch

THE TONNAGE of complex ores treated by flotation has rapidly increased. Use of chemical reagents to modify the surface of the ore particles, discovery of soluble chemical flotation reagents, and economic solution of the fine-grinding problem are the principal factors responsible for the increase. The remarkably successful operation of a number of all-flotation custom plants in treating complex ores is unquestionably due to their efficient research organizations.

A general effort is being made to raise the grade of flotation concentrates and to determine for each mill the point at which the greatest profit can be made, when the lowered freight and smelter charges on the concentrate are compared with the extra cost of concentration and greater loss in tailing. A careful study of this question has shown in a number of cases that it would pay to regrind either the flotation concentrate or middling, as the case may be, and subject the material to a second flotation. It is quite obvious that a flotation concentrate for the most part already ground to minus-200 mesh is difficult to regrind unless it is carried as an extremely thick pulp to the grinding mill and a high circulating load maintained in the classifier-ball-mill circuit. Consequently, concentrate or middling to be ground generally goes to a desliming classifier of the drag type; sand from this classifier goes direct to the mill, and the overflow goes to a thickener, from which the thickened discharge also goes to the regrinding mill. An alternative arrangement, and one that has proved satisfactory, is the use of the Genter thickener, in which case the product to be ground goes direct to the thickener. The mill, as a rule, is operated in closed circuit with a bowl classifier, and high circulating loads, up to 1,000 per cent, are recommended.

Many kinds of flotation machines are made, but when compared to a few well-known types of standard machines, the majority have little special merit. In the flotation of lead-zinc ores practice seems to favor the use of sub- aëration machines for lead and standard spitz type machines for zinc. The pneumatic type machine has come much to the fore with the development of a new type of cell known as the MacIntosh, which uses a revolving blanket. Blanket troubles caused by banking and clogging are eliminated by this type of construction. The cell is especially adaptable for selective separations.

New Reagents Constantly Being Developed

A number of new flotation reagents of great merit have been developed recently. Cresylic acid reconstructed with phosphorous pentasulphide is a new reagent which is highly selective in the presence of sulphides of iron and can be used on copper-zinc or lead-zinc ores. "Flotagen S" and "Flotagen" are two other new reagents. The former functions with cyanide, sodium sulphite, and also with sodium thiosulphate. Flotagen, which should be added as a solid, can be used only in alkaline pulps and requires sufficient agitation before flotation to allow it to go into solution, although violent mechanical agitation is not necessary. Flotagen S, on the other hand, goes into solution readily and should not be in contact with the ore pulp for more than one minute before flotation. It is not advisable to allow Flotagen to remain in contact any longer than necessary, as there is often a marked decrease in efficiency if the time is prolonged. The use of xanthate, phospho-cresylic acid, and other soluble flotation agents has been found to have a beneficial effect on the filtration of the flotation concentrate. By the substitution of these reagents for oils it has been found, in some cases, that the tonnage handled by the filters can be doubled.

The length of time that the modifying reagent is allowed to remain in contact with the ore before flotation is a most important factor and until recently has been more or less disregarded. General practice has been to take care of the time element by adding the reagents to the ball mill. This was effective in most cases, but took care only of the flotation of the first mineral. It has been found advisable to provide time contact for certain reagents used for the flotation of the second mineral. Improved results have been obtained and the consumption of reagents has been lessened by increasing the time of contact before floating the first mineral, by adding conditioning tanks equipped with agitating devices. Present practice uses up to 2½ hours' contact before the lead separation and up to one hour between the lead and zinc separations. The time factor depends of course entirely on the ore being treated, some ores requiring only a few minutes. The claim that violent agitation is necessary during the time contact is, in my opinion, a mistaken assertion.

Oxidation Must Be Avoided

It is the experience of those in charge of concentrators for the flotation of heavy sulphide ores that to obtain maximum recovery the ore must be freshly broken, and that only a small supply of broken ore can be carried in the stopes, as the slightest oxidation interferes with the flotation, and heavy losses result. This applies particularly to the taking of samples which are to be used for experimental work. I have frequently found it necessary to request that new samples be taken and shipped from freshly mined ore because of the difficulty in obtaining any separation on previous samples sent. The second samples, taken as requested, responded readily to selective flotation.

Oxidation may also take place in the grinding mills when heavy sulphides are being treated. Serious difficulty has been experienced in some mills with this problem. The condition is undoubtedly caused by the heat generated at the point of contact by the impact of the

balls striking the lumps of sulphide ore. The action can be overcome by increasing the classifier capacity and building up a high circulating load to the mill so as to keep the pulp in the mill only a very short time; by the addition of modifying reagents in the proper amount; or by carrying a more dilute pulp in the grinding mill at the sacrifice of capacity.

Two Methods of Selective Flotation

There are two different methods of applying selective flotation to an ore: The first, and the one which is more commonly used, is a straight flotation separation made on the original pulp. The second method is by bulk flotation of the two or more valuable minerals and the subsequent separation of them by selective flotation. Although each method has a distinct field of its own, there is generally little room left for argument as to which method should be used, provided sufficient information on the character and behavior of the ore has been obtained by previous experimental work. An ore containing 2.25 per cent lead and 6 per cent zinc, provided no interfering soluble salts are present, calls for a straight selective float. But if the lead were around 1 per cent or less, a bulk float of both the lead and zinc with a selective separation of the bulk concentrate would probably be the better method. In the latter case, if possible, only a part of the zinc should be cut with the lead. This would be possible, usually, because of the better floating properties of the lead, and by deferring addition of the copper sulphate reagent used to promote the flotation of zinc until after the lead had been floated. By this method the tonnage of bulk concentrate to be treated in the time-contact tanks would be much less than if the whole of the zinc had been floated. The ratio of lead to zinc would also be higher, which would assist the separation to be obtained between the lead and zinc in the subsequent selective separation. In an ore containing soluble copper salts, a bulk flotation of the zinc and lead is practically always necessary. The reason for this is the amount of modifying reagents necessary to overcome the activating action of the copper salts on the zinc.

In the general practice of bulk flotation the zinc concentrate is obtained as a tailing from the flotation of the lead. With an ore containing a large proportion of pyrite, considerable trouble may be expected from the iron, which will tend to float in the bulk concentrate. As a rule it is found impossible to reactivate the zinc mineral after the bulk concentrate has been subject to the time-contact treatment with the reagents required to effect the separation. The iron which had floated would remain with the zinc, preventing, possibly, the production of a shipping grade of zinc concentrate.

Heavy Sulphides Containing Zinc

Heavy sulphide copper ores frequently contain small amounts of zinc. Such an ore having an approximate analysis of copper 1.8, zinc 0.6, and iron 20 per cent or higher, and also containing considerable soluble sulphates, could be concentrated for the copper content alone, the zinc being discarded. The copper concentrate, however, would probably carry 5 per cent zinc. This amount would be objectionable to the smelter. The reagent costs would be too high, owing to the presence of soluble salts, to attempt to retard the zinc by ordinary methods. Flotation of a bulk concentrate containing the copper, zinc, and part of the iron would in all probability give a product which it would pay to work on for the production of a marketable zinc concentrate.

On the other hand, a heavy sulphide ore containing 2 per cent of copper and 6 per cent of zinc lends itself much better to a straight selective flotation. Another point is that should the proportion of zinc in the above-noted ore be raised to 10 per cent, the copper concentrate would carry a much greater amount of zinc and the final recovery of zinc might be lower than from the first example.

The Problem of Soluble Salts in the Ore

Some ores contain soluble salts, such as sulphates of iron, alumina, magnesium, and copper, in such quantities that even the addition of large amounts of soda ash or lime will not prevent destruction of the modifying reagents as quickly as they are added, thus preventing them from fulfilling their function. There are in general two ways of attacking such a problem: (1), to endeavor to make a bulk concentrate with the idea of subsequently making the selective separation on the bulk concentrate; and, (2), to wash the ore by crushing and partly dewatering and again bringing the pulp to the required density by the addition of fresh alkaline water. Ores of the above-noted characteristic present a research problem the solution of which will tax the ingenuity of the metallurgist. Fortunately, mining companies which have been successful in overcoming such difficulties are showing a very fair attitude by publishing their methods.

Owing to separate problems involved in the work from which the information contained in this article has been obtained, the method of presentation will be confined to giving examples of the separations obtained on different types of ore and the methods and reagents used to obtain them.

Modifying Reagents

That the reader may understand better the methods used in obtaining these separations, a brief description of the uses of some of the more common modifying reagents will be given.

Lime—This reagent was one of the first to be used in flotation. It requires a time contact with the ore and, if possible, should be added in the grinding mills. It is used to overcome the deleterious effect of soluble salts which are frequently present in ores, but its principal use is as a depressant for iron sulphides in the selective separation of lead and zinc, copper and zinc, and copper and iron sulphides. It also has a marked depressing action on zinc sulphides in their separation from lead and copper. If added in too large amounts it will also prevent the lead from floating. Chalcopyrite will float in a strongly alkaline pulp, but chalcocite and some of the other copper minerals are affected by the least excess. Therefore, lime should not be used in their flotation. As a general rule, much better results can be obtained in the flotation of these minerals with a combination of soda ash and cyanide than with lime.

Soda ash (sodium carbonate)—This is used for much the same purposes as lime, but its action is much less severe. Its action as a depressant on sulphides of iron is not great, but its great value in flotation arises from its property of increasing the differences between the relative floating properties of two or more minerals,

such as zinc and iron sulphides, so that a sharper separation between the two minerals can be obtained.

Sodium bicarbonate—The use of this reagent is preferred in the selective separation of lead and zinc when the ore contains only a minor amount of pyrite or pyrrhotite.

Sodium cyanide—This is one of the most valuable of all modifying reagents, since by its action the surfaces of the zinc sulphides and iron sulphides are modified so that they do not float. By taking advantage of this action, lead and copper sulphides may be separated from them. As a rule, cyanide is used with either soda ash or lime, generally with soda ash. It is frequently used in combination with zinc sulphate, in which case the solutions of the two salts are brought together just as they enter the flotation pulp so as to form an emulsion of zinc cyanide. Time contact is important when using cyanide, some ores requiring one hour contact, others only a few minutes' contact.

Sodium sulphite and thiosulphate—These two salts have similar properties. Sometimes one is the more effective, sometimes the other, depending entirely on the ore. They are used for the same purpose as cyanide and often have been found just as effective.

Zinc sulphate—This is used as a depressant for zinc in separations of lead and zinc. It is possible that its use might be extended to the separation of copper and zinc.

Sodium acid phosphate—This is used occasionally as a depressant for zinc in lead and zinc separations.

Sodium hydrosulphite—This can be used also as a depressant for zinc.

Sodium dichromate—This salt is used in the selective separation of lead and zinc with cyanide, on ores which contain large amounts of iron sulphides. It seems to have a beneficial action, but is seldom necessary.

Copper sulphate—This is added in quantities of one-half to two pounds per ton, as a decided activating agent in the flotation of zinc.

Ores Containing Lead, Zinc, and Iron Sulphides

In general, the selective separation of lead and zinc is obtained by the addition to the ore pulp of some reagent that will temporarily deaden the floating properties of the zinc, thus permitting the recovery of a high-grade lead concentrate. The separations are made more difficult by the presence of large amounts of iron sulphides, both pyrite and pyrrhotite, and then some reagent must be used which will permanently deaden these two sulphides so that they will not float with either the lead or zinc. The only reagents used which perform both these functions are sodium cyanide, sodium sulphite, and sodium thiosulphate, but the following have been used with some success in temporarily deadening the zinc; zinc sulphate, solium acid phosphate, and sodium hydrosulphite. The action of zinc sulphate is much more effective when used with sodium cyanide, the two being mixed by bringing the streams of the two reagents together just as they enter the flotation pulp. These reagents when used separately seem to have no effect in preventing the iron sulphides from floating.

These modifying reagents are used in an alkaline pulp, either with soda ash or lime. Lime has a permanent deadening effect on pyrite and pyrrhotite, and also affects galena in the same way but to a lesser degree. Cases have been reported of sodium sulphide being used to effect a separation between lead and zinc, but, with the exception of one instance, no success has been obtained with it in our laboratories. By the use of copper sulphate, the action of these modifying reagents is destroyed, and the flotative properties of the zinc minerals are revived. The length of time the modifying reagent is in contact with the ore is important. As a general rule it may be stated that the effect of a small amount in contact for a long period approaches the effect of a larger amount in contact for a shorter period. Mills are now erected in which surge tanks are used to increase the time that the modifying reagents are in contact with the ore.

The use of pilot tables for indicating the work the flotation machines are doing is recommended wherever possible. If the lead and zinc separations are not perfect enough, the flotation concentrate may be tabled without causing undue losses. The action of flotation coagulates the fine mineral grains so that they settle much more rapidly and there is not the same tendency for the fine mineral to be lost in the overflow of the thickeners.

Selective Flotation of Lead-Zinc Ores

1. The ore consisted of galena and sphalerite with silver, the sulphides being disseminated throughout the gangue, requiring fine grinding. Analysis: Pb, 7.10 per cent; Zn, 14.06; Ag, 3.04 oz. per ton; Au, trace. The ore was ground to 50 mesh for flotation. Small-scale tests only were made.

Product	Weight, Per Cent	Assays Pb, Per Cent	Assays Zn, Per Cent	Assays Ag, Oz.	Per Cent Recovery Pb	Per Cent Recovery Zn	Per Cent Recovery Ag
Lead conc.	13.6	48.90	8.45	9.06	77.0	8.5	45.6
Zinc conc.	24.5	6.25	46.95	5.30	17.7	84.7	47.9
Tailing	61.9	0.75	1.49	0.29	5.3	6.8	6.6

Reagents used:	Pounds per Ton	
Soda ash	4.0	Added and ground with ore
Cyanide	0.5	Added and ground with ore
Thiocarbanilide	0.2	Added and ground with ore
Zinc sulphate	0.5	Added and ground with ore
Pine oil	0.1	Added to lead cell
Copper sulphate	1.0	Added to zinc cell
Xanthate	0.3	Added to zinc cell
Pine oil	0.1	Added to zinc cell

Both cyanide and zinc sulphate were used to modify the flotation properties of the zinc and pyrite. On this particular ore, the addition of zinc sulphate gave a sharper separation between the lead and zinc than was obtained with cyanide alone. The length of time the ore was kept in contact with the cyanide was found to be an important factor. A mill is under construction based on the results of these tests.

2. The ore was a heavy sulphide type containing gold, silver, galena, sphalerite, pyrite, and pyrrhotite, with very little gangue. It required grinding to approximately 65 mesh for flotation. Analysis: Cu, 0.73 per cent; Pb, 18.47; Zn, 23.54; Ag, 19.42 oz. per ton; Au, 0.42 oz. Small-scale tests only were made.

Product	Weight, Per Cent	Assays Per Cent Pb,	Assays Per Cent Zn,	Assays Au, Oz,	Assays Ag, Oz.	Per Cent Recovery Pb	Per Cent Recovery Zn	Per Cent Recovery Au	Per Cent Recovery Ag
Lead conc.	32.7	52.31	10.97	0.80	46.3	93.0	13.2	63.9	81.3
Zinc conc.	41.1	2.31	47.69	0.16	5.74	5.2	83.3	16.1	12.7
Table conc.	5.2	....	....	0.90	9.80	....	....	11.4	2.7
Tailing	21.0	1.25	1.25	0.17	2.93	1.8	1.4	8.6	3.3

Reagents used:	Pounds per Ton	
Soda ash	6.0	Added and ground with ore
Thiocarbanilide	0.2	Added and ground with ore
Sodium cyanide	0.3	Five minutes' contact
Cresylic acid	0.2	Added to lead cells
Copper sulphate	1.25	Added to zinc cells
Xanthate	0.4	Added to zinc cells
Pine oil	0.1	Added to zinc cells

A mill, based on the results of these tests, has been built and is in successful operation.

3. The following separation was obtained on dump middlings consisting of sphalerite, pyrite, and pyrrhotite, and

only 2 to 3 per cent gangue. Analysis: Pb, 2.45 per cent; Zn, 23 per cent. The results are of a 5-ton test.

Product	Assays, Per Cent Pb	Zn	Approximate Recoveries, Per Cent Pb	Zn
Lead concentrate	16.50	12.40	85	..
Zinc concentrate	0.30	51.62	..	91
Tailing	0.45	0.85	..	..

Reagents used:	Pounds per Ton	
Soda ash	18.0	Added and ground with ore
Cyanide	0.26	Added to lead cells
Acid coal-tar creosote	0.21	Added and ground with ore
Water-gas tar	0.21	Added and ground with ore
Copper sulphate	2.0	Added to zinc cells
Xanthate	0.4	Added to zinc cells

A mill, based on these results, has been built and is in operation.

4. The sulphides in this ore consisted of sphalerite, galena, pyrrhotite and a little pyrite and chalcopyrite, also gold and silver. Analysis: Pb, 1.96 per cent; Zn, 5.52; Fe, 7.42; Ag, 3.28 oz. per ton; Au, 0.02 oz. Results of a 5-ton test:

Product	Assays: Per Cent Zn,	Per Cent Pb,	Per Cent Fe,	Au, Oz.	Ag, Oz.	Approximate Recoveries, Per Cent Pb	Zn
Lead conc	4.17	51.09	2.60	0.30	40.0	89.4	....
Zinc conc	47.18	1.15	....	....	9.0	....	94.8
Tailing	0.30	0.15	9.4	....	....	....	....

Reagents used:	Pounds per Ton	
Soda ash	2.0	Added and ground with ore
Acid creosote	0.2	Added and ground with ore
Water-gas tar	0.2	Added and ground with ore
Sodium cyanide	0.15	Added to lead cells
Cresylic acid	0.4	Added to lead cells
Copper sulphate	1.0	Added to zinc cells
No. 2 neutral creosote	0.4	Added to zinc cells
TT mixture	0.2	Added to zinc cells
Pine oil No. 5	0.2	Added to zinc cells

5. The ore consisted of sulphides of iron, copper, lead, and zinc, finely crystalline and intimately associated. It also carried silver and gold. Analysis: Cu, 2.35 per cent; As, 0.76; Pb, 1.26; Zn, 14.25; Au, 0.03 oz. per ton; Ag, 3.91 oz. per ton; Sb, trace. Results of small-scale test:

Product	Weight, Per Cent	Assays: Cu, Per Cent	Pb, Per Cent	Zn, Per Cent	Au, Oz.	Ag, Oz.	Per Cent Recovery: Cu	Pb	Zn	Au	Ag
Cu-Pb conc.	17.0	12.32	6.62	13.86	0.08	14.76	90.3	93.3	16.3	41.6	70.0
Zinc conc...	23.0	0.56	0.25	49.6	0.04	3.0	5.5	4.2	80.5	29.1	19.6
Tailing.....	60.0	0.16	0.05	0.7	0.015	0.56	4.1	2.5	3.0	28.3	9.5

Reagents used:	Pounds per Ton	
Soda ash	10.0	Added and ground with ore
Thiocarbanilide	0.25	Added and ground with ore
Sodium cyanide	0.24	Added and ground with ore
Pine oil	0.10	Added to lead cells
Copper sulphate	1.5	Added to zinc cells
Xanthate	0.3	Added to zinc cells
Pine oil	0.1	Added to zinc cells

6. This sample consisted of material taken from a tailing dump resulting from the concentration of a lead-zinc ore. Analysis: Pb, 0.07 per cent; Zn, 10.06 per cent. Results of 4-ton test:

Product	Assays, Per Cent Pb	Zn	Cu	Approximate Recoveries, Per Cent Pb	Zn
Lead conc	22.81	10.41	4.23	74	..
Zinc conc	0.14	49.09	....	..	85
Tailing	0.06	0.40	....	..	..

Reagents used:	Pounds per Ton	
Soda ash	2.0	Added and ground with ore
Acid coal-tar creosote	0.3	Added and ground with ore
Sodium cyanide	0.09	Added to lead cells
Cresylic acid	0.6	Added to lead cells
Copper sulphate	1.24	Added to zinc cells
Xanthate	0.25	Added to zinc cells
Pine oil	0.25	Added to zinc cells

7. This sample was a lead-zinc ore carrying silver. The galena and sphalerite were intimately disseminated with pyrite and pyrrhotite. Analysis: Pb, 3.35 per cent; Zn, 7.08; Fe, 4.82; Ag, 9.5 oz. per ton. Results of small-scale test:

Product	Weight, Per Cent	Assays: Pb, Per Cent	Zn, Per Cent	Ag, Oz.	Per Cent Recovery: Pb	Zn	Ag
Lead conc	6.0	46.53	2.74	134.0	80.9	2.2	72.2
Load midd	5.9	9.02	6.88	28.5	15.5	5.6	15.2
Zinc conc	10.9	0.32	55.32	4.5	1.0	82.7	4.4
Zinc midd	3.5	0.80	15.16	7.44	0.8	7.4	2.4
Tailing	73.7	0.08	0.21	0.88	1.7	2.1	5.8

Reagents used:	Pounds per Ton	
Soda ash	5.0	Added and ground with ore
Thiocarbanilide	0.2	Added and ground with ore
Sodium cyanide	0.24	Added to lead cells
Cresylic acid	0.75	Added to lead cells
Copper sulphate	1.0	Added to zinc cells
No. 2 neutral creosote	0.5	Added to zinc cells
Xanthate	0.1	Added to zinc cells

ORES OF INTIMATELY MIXED CHALCOPYRITE, PYRITE, AND PYRRHOTITE WITH AND WITHOUT GOLD

Successful separation of chalcopyrite from the iron sulphides, both pyrrhotite and pyrite, requires the solution of two problems. The first problem is to free the copper mineral from the iron. Fine grinding is nearly always necessary, owing to the intimate association of chalcopyrite with the pyrite. Developments within the last few years in the art of fine grinding make it possible to free economically the two minerals in the finest grained ores. The second problem is to prevent the iron from floating with the copper. With chalcopyrite ore containing no gold this can generally be done by maintaining a pulp strongly alkaline with lime. Lime has a permanent deadening effect on pyrite and pyrrhotite, and very high ratios of concentration can be obtained.

As a general rule, copper ores containing gold present an entirely different problem, that of recovering the gold in the copper concentrate. The use of lime to retard the iron, except in rare instances, tends to throw the greater part of the gold with the iron tailing. Soda ash or caustic soda is used because it has not the detrimental effect on the gold, but unfortunately it does not deaden the pyrite. Its effect is sufficient to keep the pyrrhotite from floating, but pyrite floats readily. Soda disperses or deflocculates the gangue slime, whereas lime coagulates it. However, soda also seems to tend to coagulate the sulphides.

Sodium cyanide added to a pulp, the alkalinity of which is maintained with soda ash, can be used permanently to deaden at least a part of the pyrite, but it also often has a modifying effect on the chalcopyrite. The chalcopyrite can be reactivated by the addition of a limited amount of copper sulphate. By the use of cyanide under these conditions, it is often possible to obtain a higher ratio of concentration without lowering the recovery of the gold.

SELECTIVE SEPARATION OF COPPER-IRON ORES WITH AND WITHOUT GOLD

1. This ore was a complex sulphide consisting of chalcopyrite intimately associated with pyrite. The chalcopyrite was disseminated throughout the pyrite, the sulphides constituting 80 per cent of the ore. The ore was ground to pass 100 mesh, 75 per cent being —200 mesh. Analysis: Cu, 3.0 per cent; Fe, 40.0; "insoluble," 7.5; other gangue, 4.5; S, 45.0 per cent. Results of tonnage-scale test:

	Per Cent Copper
Copper concentrate	22.77
Tailing	0.12
Recovery, per cent	96

Reagents used:	Pounds per Ton	
Lime	10.1	Added to ball mill
Barretts No. 634	0.6	Added to ball mill
TT mixture	0.25	Added to cells

2. The ore was a copper-gold ore from the Rouyn district, Quebec. Analysis: Cu, 4.60 per cent; Fe, 19.83; SiO_2, 50.64; Ag, 0.22 oz. per ton; Au, 0.04 oz. Small-scale tests only:

Product	Weight, Per Cent	Assays: Cu, Per Cent	Au, Oz.	Per Cent Recovery: Cu	Au
Copper conc	35.3	12.14	0.11	95.0	81.1
Copper midd	8.5	1.39	0.04	2.6	7.1
Tailing	56.2	0.19	0.01	2.4	11.8

Reagents used:	Pounds per Ton	
Soda ash	4	Added to ball mill
Xanthate	0.07	Added to cells
Pine oil	0.05	Added to cells

3. This is a copper-gold ore from the Rouyn district, Quebec. Analysis: Cu, 1.6 per cent; Au, 0.28 oz. per ton. Small-scale tests only:

Test	Product	Weight, Per Cent	Assays Cu, Per Cent	Assays Au, Oz.	Recovery Per Cent Cu	Recovery Au
A	Copper conc	31.4	4.77	0.76	90.4	85.2
	Tailing	69.1	0.11	0.06	9.6	14.8
B	Copper conc	22.9	6.50	0.98	94.1	80.06
	Tailing	77.1	0.12	0.07	5 9	19.94

Reagents used:	Pounds per Ton	
A Soda ash	6.0	Added to ball mill
No. 4 creosote (Barretts)	0.4	Added to ball mill
Cresylic acid	0.4	Added to cells
B Soda ash	6.0	Added to ball mill
Cyanide	0.2	Added to ball mill
No. 4 creosote	0.2	Added to ball mill
Water-gas tar	0.05	Added to ball mill
Xanthate	0.05	Added to cells
Copper sulphate	0.4	Added to cells

Note: The use of copper sulphate in test *B* was found necessary to reactivate the chalcopyrite which had been affected by cyanide.

Ores of Intimately Mixed Chalcopyrite, Sphalerite, and Iron Sulphides

This type of ore probably presents the most difficult of all selective flotation problems. The use of cyanide temporarily to deaden the zinc and permanently to deaden the iron sulphides seems essential. However, laboratory separations have been obtained by floating the copper in an alkaline pulp by the addition of lime. For the flotation of the zinc the copper tailing was dewatered to eliminate a part of the lime and the pulp then brought up to the required density by addition of fresh water. At this point soda ash was added and the zinc floated in a soda ash pulp, copper sulphate being used to help reactivate the zinc.

Selective Separation of Copper and Zinc From Pyrite and Pyrrhotite Gangues

1. This was a copper-zinc ore from the Rouyn district, Quebec. The sample contained sphalerite and chalcopyrite together with a little gold and silver associated in a heavy sulphide gangue. The copper and zinc sulphides were finely disseminated, so fine grinding was required. Analysis: Cu, 4.15 per cent; Zn, 10.0; Ag, 3.02 oz. per ton; Au, 0.18 oz. Small-scale tests only:

Product	Weight, Per Cent	Assays Cu, Per Cent	Assays Zn, Per Cent	Assays Au, Oz.	Assays Ag, Oz.	Recovery Per Cent Cu	Recovery Zn	Recovery Au	Recovery Ag
Copper conc	17.3	20.66	6.91	0.56	11.96	85.5	11.8	50.3	65.7
Zinc conc	14.6	1.96	48.57	0.32	1.39	6.9	69.8	24.3	6.4
Zinc midd	8.1	1.30	11.37	0.30	3.80	2.6	9.1	12.7	9.8
Tailing	61.0	0.35	1.56	0.04	0.93	5.0	9.3	12.7	18.1

Reagents used:	Pounds per Ton	
Soda ash	10.0	Added to ball mill
Cyanide	0.5	Added to ball mill
Thiocarbanilide	0.2	Added to ball mill
Cresylic acid	0.2	Added to copper cells
Copper sulphate	1.0	Added to zinc cells
Xanthate	0.3	Added to zinc cells

2. This was a copper-zinc ore from the Rouyn district, Quebec. The sample contained sphalerite and chalcopyrite togther with a little gold and silver in a heavy sulphide gangue. The copper and zinc sulphides were finely disseminated, so fine grinding was required to free them. Analysis: Cu, 7.36 per cent; Zn, 6.53; Pb, trace; Fe, 35.40; "insoluble," 18.6 per cent; Au, 0.03 oz. per ton; Ag, 2.45 oz. Small-scale tests only:

Product	Weight, Per Cent	Assays Cu, Per Cent	Assays Zn, Per Cent	Assays Au, Oz.	Assays Ag, Oz.	Recovery Per Cent Cu	Recovery Zn	Recovery Au	Recovery Ag
Copper conc	28.0	23.74	3.68	0.80	7.04	93.0	16.1	75.4	76.0
Zinc conc	9.8	1.22	47.38	0.01	0.81	1.7	72.9	3.4	3.1
Zinc midd	9.7	1.07	3.68	0.01	0.61	1.4	5.6	3.4	2.3
Tailing	52.5	0.53	0.65	0.01	0.92	3.9	5.4	17.8	18.6

Reagents:	Pounds per Ton	
Soda ash	4.0	Added to ball mill
Sodium cyanide	0.3	Added to ball mill
Thiocarbanilide	0.2	Added to ball mill
Cresylic acid	0.08	Added to ball mill
Copper sulphate	0.4	Added to copper cells
Copper sulphate	1.5	Added to zinc cells
Xanthate	0.3	Added to zinc cells
Pine oil No. 5	0.08	Added to zinc cells

3. The ore contained: gold 0.099 and silver 1.36 oz. per ton; copper, 1.89; zinc, 4.61; and lead, 0.45 per cent. It was ground to 95 per cent minus-200 mesh for the test work. A large amount of research work has been carried out on this ore by different people. The best results obtained so far are with the following methods, two of which will be described.

Method No. 1—Lime, 3 lb. per ton, was added to the ball mill while grinding. Agitated with 1 lb. per ton salt for 3 minutes. Floated copper with 0.12 lb. per ton xanthate and 1 drop pine oil. Reclean concentrate with ½ lb. per ton salt, 0.02 lb. per ton xanthate, and 1 drop pine oil. Agitated with 1 lb. per ton lime and ¼ lb. per ton copper sulphate. Floated zinc with 0.12 lb. per ton xanthate and 1 drop cresylic acid. Recleaned concentrate with 0.1 lb. per ton copper sulphate, 1 lb. per ton lime, and 0.02 lb. per ton xanthate.

Method No. 2—Agitated with 3 lb. per ton soda ash, 1 lb. per ton sodium sulphite, and ¼ lb. per ton sodium cyanide. Floated copper with 0.12 lb. per ton xanthate and 1 drop pine oil. Recleaned with 1 lb. per ton soda ash, ½ lb. per ton sodium sulphite, and 0.01 to 0.02 lb. per ton xanthate. Agitated with 1 lb. per ton soda ash, ¼ lb. per ton copper sulphate, and 1 lb. per ton sodium sulphite. Floated zinc with 0.12 lb. per ton xanthate and 1 drop cresylic acid. Recleaned with 1 lb. per ton soda ash, ½ lb. per ton sodium sulphite, 0.01 lb. per ton xanthate, and 1 drop pine oil.

The following results were obtained from the first method, and to approximate continuous operation a series test was made. The copper was floated as a rougher concentrate which was recleaned, the tailing from the cleaning being added to another batch of ore before this batch was floated for the copper. Tailing from the copper flotation was floated for zinc, and a rougher zinc concentrate made. This was recleaned and the tailing from recleaning added to the copper tailing from the second copper flotation. The test was run continuously on fifteen charges of ore, 1,500 grams to the charge. The results follow:

	Copper Concentrate: Assay	Copper Concentrate: Per Cent Metal Contained	Copper Concentrate: Ratio of Concentration	Zinc Concentrate: Assay	Zinc Concentrate: Per Cent Metal Contained	Zinc Concentrate: Ratio of Concentration	Tailing: Assay	Tailing: Per Cent Metal Contained
Cu	17.0	83.0	10.85	1.1	5.05	11.3	0.28	11.95
Zn	3.0	5.97	.....	43.5	83.2	....	0.6	10.83
Au	0.53	48.5	.....	0.03	26.4	....	0.06	25.10
Ag	4.90	33.1	.....	1.6	10.4	....	0.94	56.5
Pb	4.4	90.0	.....	0.0	0.0	....	0.05	10.0

Separation of Chalcopyrite and Galena

Chalcopyrite and galena are being successfully separated in actual mill operation. Previous to the operation of the selective separation, the two minerals were collected in the one concentrate and shipped to the smelter. The operation of the selective separation to produce separate lead and copper concentrates increased the net returns per ton of crude, in one instance, by $4.65 per ton.

Separation is effected by floating a bulk concentrate containing the lead and copper. This concentrate is subjected to a time contact with the required modifying reagents until sufficient action has taken place to prevent the copper from floating. The pulp is then floated to produce a lead concentrate, a copper concentrate being obtained as a tailing. The ore contains approximately: lead, 6.9; copper, 2.36; iron, 25.0; and "insoluble," 24.4 per cent. An average day's run gives:

	Assay, Per Cent Pb	Cu	Fe	"Insoluble"
Feed	6.0	1.75	....	.....
Pb concentrate	51.7	2.7	4.1	21.6
Cu concentrate	3.9	22.7	24.1	15.5
Tailing	0.7	0.3	....	.....

The flow sheet of this separation follows: The feed goes to a 10-ft. MacIntosh cell, tailing from this to a second 10-ft. cell. The froth from the second is returned to the first; the rougher froth goes to a cleaner and recleaner. This re-

cleaner froth, which is a bulk concentrate containing lead and copper, goes to the time-contact tanks, where reagents are added to effect selective separation. The pulp then comes back to a MacIntosh cell for the lead-copper separations. Tailing from this cell is the copper concentrate. The froth is recleaned in another MacIntosh cell, which makes the final lead concentrate. Tailing from this cell is returned to the cleaner, which cleans the bulk concentrate, and the tailing from the bulk concentrate cleaner goes back to the head of the circuit.

The reagents used are approximately as follows: Ore ground with: soda ash 5.0, sodium cyanide 0.5, zinc sulphate 2.0, thiocarbanilide 0.1, and xanthate 0.1 lb. per ton. The ore is then floated with the addition of xanthate, 0.16 lb. per ton, added to the cells. This produces a bulk concentrate which is given a time contact of 15 minutes with lime 1.0, and cyanide 0.5 lb. per ton; and then floated for the lead concentrate with TT or T&A mixtures.

The results of the experiments given here are not confined to laboratory experiments; they can, under proper control, be obtained in actual milling operations, and in general they can be improved upon. Selective flotation is no longer an uncertain operation, and no mining company should hesitate to adopt it on this account. The increasing number of custom flotation plants in the United States is the proof of the truth of this statement.

If possible, a small pilot plant should be erected at first to develop proper methods of control. The controlling conditions must not only be known, but must be maintained in actual operations. Some idea of the delicate control required is obtained when it is considered that often twelve or more different reagents are being used in quantities varying from one-tenth of a pound to ten pounds per ton. If it is not possible to build a pilot plant, then the next best procedure is to have tonnage scale tests made at some laboratory equipped to perform them. In this connection I may add that it is desirable for the company to have its own engineer representative present during the tests.

U. S. Production of Mercury Dropped 17 Per Cent in 1926; Consumption Gained

Mercury production of the United States in 1926 amounted to 7,645 flasks of 75 lb. each, according to the preliminary figures compiled by the U. S. Bureau of Mines. Imports were 28,614 flasks. The average New York price for the year was $91.90. In 1925 the domestic output was 9,174 flasks, imports were 22,781 flasks, and the average New York price was $83.13. The total value of the 1926 domestic production based upon the average New York price for quicksilver for the year was $702,598.

The 1926 production was made by seven mines in California, by nine mines in Arizona, Idaho, Nevada, Texas, and Washington, and by one mine in Alaska. Production from Alaska is from the Iditarod district and is the first of record for many years. Imports of mercury were 11,768 flasks derived from Italy, 14,117 from Spain, and 2,729 flasks from the rest of the world. Exports were 116 flasks. On Dec. 31, 1925, there were 1,181 flasks in bonded warehouses; on Dec. 31, 1926, 2,277 flasks.

Outstanding features of 1926 are decreased domestic production and increased imports, with a material increase in price. The large consumption indicated may be attributed in part to the manufacture of radio tubes, and a considerable amount is consumed in industries making electrical appliances and corrosive sublimate.

Mississippi Flood the Greatest in History

Mining, along with other industries in the flooded areas of the Mississippi Valley, is faced with heavy losses. The U. S. Department of Agriculture, in an article just issued, reviews the service of the Weather Bureau in issuing flood warnings. The article states that the floods began as far back as last October as a result of heavy rains in August and September. They have gone on all winter in one region or another, augmented by rain, and more rain, swelling the smaller waterways, which in turn swelled the greater, until there ensued the terrible devastation that is being produced by the Mississippi.

The first flood of importance was that of the Neosho River, in Kansas and Oklahoma, in October. This was the greatest flood on record for that region. Then came more rains, extending over Ohio and the upper Mississippi Valley. These rains caused floods in all streams tributary to the Ohio. Normally October and November are the season of lowest water in rivers, yet in 1926, in early winter, nearly all the rivers in the Mississippi system, if not at "bankful" stage, were at least at a stage much above normal. It was apparent that with winter and early spring rainfall above normal any considerable increase must make big floods in the spring.

The rains came. The first great floods were in the southern tributaries of the Ohio, especially the Cumberland and Tennessee rivers. Both went into "great flood" during the last days of 1926, so much so that the flood in the Cumberland was the greatest ever known in that river. These floods immediately filled all the lower Ohio above the flood stage. Later in January there was a big flood in the upper Ohio, which rose to nearly 30 ft. at Pittsburgh and above 59 ft at Cincinnati. Then it began to rain more generally. Kansas and Oklahoma, Mississippi, Arkansas, Missouri, Illinois, southern Iowa, western Kentucky, western Tennessee, and later, Louisiana, all had heavy rains. The rains occurred at intervals not more than two or three days apart, and occasionally they were of the torrential type. There was nothing to do but advise people to get ready for general floods.

Warnings were issued for all these floods before they began. As the rains kept on additional warnings were issued every two or three days for the lower Mississippi, from Cairo to its mouth, that still higher stages than those previously forecast would be reached. About April 13 every indication pointed to the greatest flood in the history of the lower Mississippi Valley, and at once bulletins were issued to that effect, warning everybody interested to take all possible precautions to protect life and property. These warnings were later repeated and emphasized, and since that time the Weather Bureau has issued daily advices of stages to be expected and the time when they are due. Beginning at Cairo it has been possible to make predictions of flood stages nearly a week in advance, and on going down the river warnings have been given at gradually increased periods in advance. On April 2 the Vicksburg district was advised that the crest of the flood would be reached by the end of the month. People at New Orleans were advised on April 8 that the crest would be reached there during the first week in May, and at the same time the probable crest stages were given. Later rains made it necessary to increase the forecasts of crest stages and to delay the dates therefore by five to ten days.

Official Mexican Views on Sundry Controversial Matters

Questions Regarding Mining Enterprise Answered—Government's Attitude Explained to E. & M. J. Correspondent

ALBERTO TERRONES BENITEZ, in behalf of the *Engineering and Mining Journal*, has obtained the accompanying expression of views from high officials in the Mexican Government. The policies reflected are perhaps understood in a general way by most readers; but a definite statement from men in authority should clarify some points in the situation. The first six questions are answered by the Mines Department, at the direction of Luis N. Morones, Secretary of Industry, Commerce and Labor. The last four are official statements of Aaron Saenz, Secretary of Foreign Relations.

Mr. Benitez, the interrogator, made the translations.

Question 1—Does the Mexican Government actually desire expansion on the part of companies now exploiting metal mining properties in Mexico?

The government desires the activities of the mining companies operating in the republic to be intensified. This is the origin of the most important provisions contained in the Law of Mineral Industries recently enacted. Among them, the one referring to the grouping of ten mining lots has for its object to diminish the cost of mining operation, the mining companies being in a position to consolidate their properties.

Question 2—Does the government believe that it would be to the best interests of Mexico to allow the further exploitation of its metalliferous ore deposits, to await the time when Mexican capital is available for the purpose?

Mexico recognizes the need of foreign capital for the immediate development of its mineral resources; but at the same time it deems it necessary for the welfare of the country to encourage the creation of national capital, based on a sound policy of wise nationalism.

The country needs foreign capital; but the policy of investing enterprises should be a firm and honest one. They should do their best to develop the natural resources of this country, and not considering Mexico merely as a field for illicit speculation. The essential condition demanded by the government is that such enterprises should in every respect submit to the Mexican legislation, thus paying due regard to the sovereignty of Mexico as a free nation.

Question 3—Does the government favor the introduction of labor-saving machinery in the mines, mills, and smelters so as to increase the productive output of each worker and diminish the operating cost?

The government favors the introduction of modern machinery so as to intensify operations in the mines, treatment and metallurgical plants. For that purpose the reduction of freight rates for ores and mining machinery has been taken up with the proper railroad authorities. Also the custom tariff rates have been reduced for materials employed in the mining industry; and taxation has been modified when circumstances so required, as happened in the recent drop of silver price.

Question 4—What evidence is there, if any, that the burden of taxation on foreign-owned mining property is not higher in proportion than that on other property?

The burden of taxation on mining property, as well as the taxation levied on any other kind of property, is equally distributed among tax payers without any discrimination as to nationality.

Question 5—Does the government believe that there are enough competent Mexican mining engineers to carry out the requirements of the law regarding responsibles at the mines?

According to statistical information there were in 1925 211 Mexican mining engineers, and in that epoch the mining companies bound by their operations to employ "responsible engineers" were 112 in number.

In the Engineering School of Mexico and in those of Guadalajara, San Luis Potosí, and Guanajuato, as well as in some of the universities of the United States, young Mexicans are studying mining engineering. They will in time constitute a technical reserve with which to comply with the legal requirements as regards "responsibles."

Question 6—What is the government's theory as to the principles on which minimum wage laws should be based?

The three following points should be kept in mind in order to fix a criterion on the subject of minimum wage:

(a) The "poverty minimum wage" is prevalent in any laboring community when the wage does not compensate even in a minimum proportion the physical effort of the laborer (3,500 calories for the average laborer, and 7,700 calories for the rest of his family, making a total average of 11,200 calories), thus keeping the family (five members—a typical family in Mexico)—in a complete state of penury.

(b) The "necessity minimum wage" is secured by the laborer through reiterated insistance before his employer, and in a great many times with the intervention of the nearest administrative authority; this wage does not yet constitute a reasonable compensation.

(c) The "comfort minimum wage" is the one the laborer should earn in order to avoid physical, intellectual, and moral weakening of himself and his family; the calculation of this kind of wage has been systematically held by this department as the only proper one to fit conditions in the republic.

According to the economic laws, labor is essential for production and for the development of natural resources; and in importance is identical to capital. As long as there is a surplus in profits these should be reduced, if necessary, to a minimum, for the benefit of wages that are a reasonable and fair compensation to the labor element.

It has been held as a principle in social economics that when an industry or a center of production—that is, a laboring nucleus—without detriment to capital (which would otherwise entail a real loss) is only capable of paying a "poverty minimum wage"—which is as above explained, smaller than the "necessity minimum wage" and much smaller than the "comfort minimum wage"—it would be preferable by far to have such a center suppressed than to let it assist in creating penury.

Question 7—What is the purpose of demanding the waiving of right to appeal to their home governments on the part of foreigners who desire to hold property in Mexico?

The aim of the Mexican Government when requiring all foreigners who wish to acquire property within the territory to agree before the Office of Foreign Relations that they shall be considered as Mexican citizens in respect to the acquired property, and that they shall not apply by reason thereof to the protection of their home governments, is to avoid a privileged situation on the part of foreign investors that would be detrimental to Mexican capital which has no other means for its protection but the Mexican courts. These by reason of their organization, in all respects similar to the courts of any civilized country, offer sufficient security within the provisions prescribed by our laws, for any foreigner to derive a lawful profit from his investments. The only limitation is to comply with the Mexican legislation, thus upholding the universally accepted principle that in any country its laws and courts are the only legally qualified bodies to protect and rule the property within its jurisdiction, excepting, of course, the case when the government of the affected alien party may have a right, according to the usage and principles of international law, of filing a complaint for redress before the Mexican Government.

Question 8—Is there a desire on the part of the Government to make the foreign ownership laws applicable to rights acquired prior to 1917 so far as metal mines are concerned?

As regards the possible intention of enforcing the organic law of Section I of Art. 27 of the Constitution in cases of mining property acquired prior to 1917, the same law provides that only in cases of new acquisitions, the mining corporations should amend their articles of incorporation and bylaws in the manner prescribed by Art. 6 of the regulations of the above organic law, since the mines acquired prior to 1917, excepting the above mentioned requirement, are not subject to the said organic law, their ownership and exploitation being regulated by special mining legislation.

Question 9—What is the answer to the charge of "confiscatory" legislation?

The so-called "confiscating laws" Mexico bases on the right to amend its legislation in consonance with its economic development and the necessities of its internal policies. Mexico has done nothing but act within the principles accepted by the international law and by all civilized nations of the world, which vest in every sovereign state a legislative power to modify the existing individual rights, taking only the obligation of indemnifying the parties affected by the modifications, in the manner provided for by the legislation.

Our laws do not confiscate property; they simply establish ample and prudential terms within which to transform the existing rights, and only in case of nonperformance within the required terms the law provides for the sale of the non-transformed rights, at auction according to the law, through the courts, turning the proceeds over to the foreign owner.

Too Much Questionnaire

One of the functions of the U. S. Bureau of Mines is to compile statistics of production; and naturally the original source of the data is the miner. The little fellow gets attention as well as the big company. The following reply to one of the Bureau's standard production questionnaires came to one of the Western offices, by which the authenticity is vouched for. Spelling, philosophy, and all, the letter is reproduced verbatim et literatim:

"Gents you just take my name of please as the less foolishness we have the better. I get out so little gold that its not worth mentening, about all I can do is asessment work, have no water and only expenses. Yes I have even ben in jail a whole year far the violation of the blesed 18 amendment. We need a few more sutch amendments then our country will prosper——like Hell. Yes its fine when a man works hard all day come in wett and hungry and then aint alowed a drink of boos. Yes its nice.

Yours respectfuly,

——— ———

for free Beer and Wine."

One Way of Transporting Men

The Miami Copper Co., Miami, Ariz., uses a man car with overhead and side guards such as are shown. The guards are made with a steel frame covered with chicken wire.

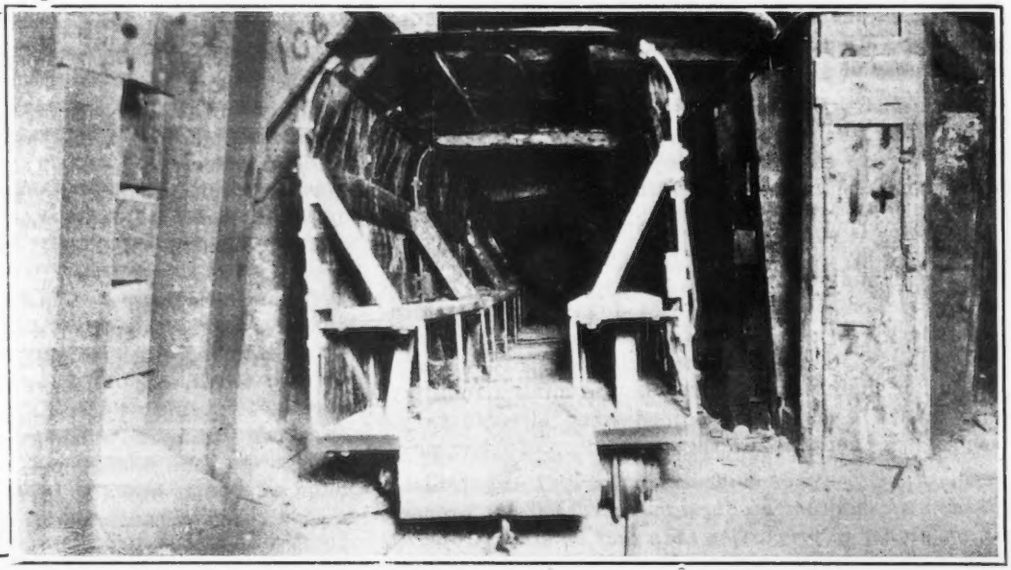


Photo by courtesy of U. S. Bureau of Mines

Looking north, the majestic Minarets Mountains rise in a series of serrate peaks

Magnetite Deposits of Madera County, California, Constitute Important Reserves

Occur in Area of Metamorphic Rocks—Economic Conditions Not Yet Favorable for Development Project

By Ellsworth Y. Dougherty
Heroult, Shasta County, Calif.

THE MINARETS MAGNETITE DEPOSITS, in Madera County, Calif., have long been considered one of the important reserves of iron ore in the West Coast region of the United States. These deposits are in the headwater drainage area of the North and Middle forks of the San Joaquin River—a region of rugged grandeur and striking rock sculpture, with deeply dissected canyons, numerous snow-fed streams, and glacier-carved lakes. Looking north from the main orebody the Minarets Mountains, a portion of the Ritter range, rise in a series of serrate peaks, as shown above, to an elevation in excess of 12,000 ft. above sea level. Iron Mountain (Fig. 1), so-called, though this peak is not iron-ore bearing, overlooks and adjoins the magnetite mineralized area. It is the most southerly of the Ritter range. Most good maps of California indicate this peak, in northeastern Madera County. Its geographical and geological setting will be emphasized by noting that Yosemite Valley is about 25 miles on an air line west-northwest of Iron Mountain and in the same geological province.

Travel to the Iron Mountain area is best made over the Mammoth Trail. This trail connects Mammoth lakes, in the high Sierras of Mono County, with an automobile road to Bass Lake, and thence through the west foothills of the Sierra Nevada Mountains to the San Joaquin Valley.

Because of its remoteness, the long snow season, rugged relief, elevation, and lack of economic development, few travelers have found it convenient to examine the magnetite deposits near Iron Mountain. In view of the growing importance of iron-ore reserves as a factor in the future industrial development of the Pacific Coast region, some detailed information, based on a personal examination is given herein.

In this ice- and snow-ridden region there is little obscuring vegetation, soil, or oxidized surface mantle, above about 9,000 to 9,500 ft. elevation (average timber line). It is possible, therefore, to obtain a comprehensive understanding of the geology even without a detailed examination of many interesting and important details. The magnetite deposits are in the bare-rock horizon above timber line, and their exposures are consequently easily traced in most occurrences.

The outstanding geological feature of the Iron Mountain area is a zone of metamorphic rocks with the longer horizontal axis striking in a general northwest direction, penetrated, truncated, embayed, and in part segmented by plutonic intrusions. In general the metamorphic rocks occupy the higher ridges and peaks, and the intrusives the slopes and depressions. The metamorphics appear to be mostly of igneous origin, and in large part of basic composition. Some fine-grained intercalations may be metamorphosed sedimentaries, and some of the metamorphics are of acid igneous derivation. The typical metamorphics are closely joined or slaty. Some formations are true schists. I do not know the age of the metamorphics other than the fact that they are older than the intrusive rocks.

These intrusives are a portion of the granodiorite batholith which forms the core of the Sierra Nevada Mountains and has a wide areal extent. This batholith is commonly ascribed to late Jurassic or early Cretaceous time. The exposed intrusive rocks in the contiguous area northwest, west, southwest and south of Iron Mountain embrace the zone of magnetite mineralization. It shows pronounced differentiation, varying from basic to ultra acid. The various differentiations may merge into the main igneous body or they may sharply cut this parent mass; or the differentiations

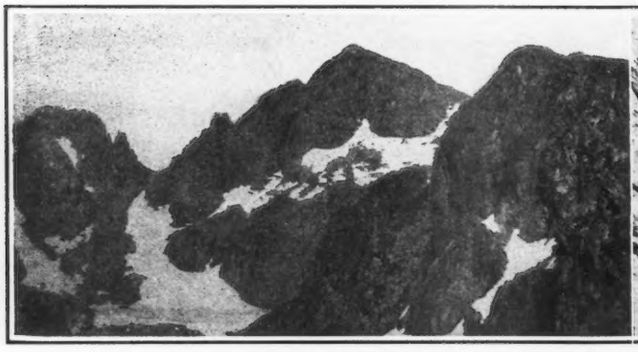


Fig. 1—Iron Mountain Peak (in center) and surroundings, looking south

NOTE: Typical structure of the metamorphic rocks. Height from frozen lake to top of peak, about 700 ft. Elevation of peak, 11,157 ft. Photo taken July 12.

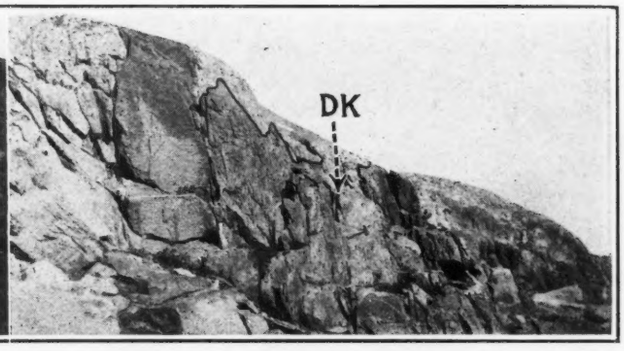


Fig. 2—Basic dikes (marked by rule and pick) intrude into granitic and metamorphic rocks

may merge into one another, or sharply cross one another. Even where sharp, many contacts are phyically inseparable and mineralogically blended. Some differentiations, however, such as aplite, pegmatite, and quartz dikes, are discrete physical units, penetrating either or both the parent igneous body and the metamorphics. In the nature of their contact relations one cannot see important differences between many of the irregular differentiations and some metallic aggregations, nor between the dikes and some mineral veins conceivably formed under similar circumstances. The ideas so frequently and forcibly emphasized by Spurr, that magmatically derived ore veins have been emplaced in essentially the same way as ordinary igneous dikes, and that these ore veins are an offspring of igneous differentiation, surely gain ground (at least for ore veins of deep-seated origin) by examination of such an area as that in the vicinity of Iron Mountain. As far as I could see the observed igneous differentiations give no evidence that they have thrust aside their containing walls. It must be admitted, however, that in the case of these Iron Mountain igneous differentiations, as well as in many cases of veins, it is conceivable that a spreading of the containing walls may have occurred without leaving its imprint. The evidence is not conclusive either for or opposed to this process.

The contact of the differentiated plutonic body (which for convenience I shall term "the granitic rocks," although on the average these rocks are more basic than granite) with the metamorphics, is characteristically sharp but frequently discordant with the slaty cleavage of the metamorphics, which the intrusives cut at random.

Both the granitic rocks and the metamorphics are penetrated by basic intrusives. Unlike the differentiations of the granitic rocks, these basic intrusives appear to have originated during a distinctly later stage of solidification than the granitic rocks.

Fig. 2 illustrates characteristic rock structures and relationships. The basic dike marked by the 2-ft. rule is bordered on the left by the granitic rocks and on the right mainly by the metamorphics. In the upper part of the exposure the dike is entirely in the granitic rock, having passed out of the metamorphic rock. The basic dike marked by the pick has metamorphic rock walls on both sides and disappears beneath the exposed surface of the granitic rock near the top of the ridge. The granitic rock contacts the metamorphics along the sinuous line as drawn. As may be noted, the strike of the slaty cleavage makes somewhat less than a 90-deg. angle with the plane of the paper, while the granitic-metamorphic contact in large part cuts across this cleavage. Since the granitic rocks do not share the slaty cleavage of the metamorphics and frequently cut across this cleavage, it is concluded that this cleavage, which is the important structural feature of the metamorphics, existed prior to the intrusion of the granitic rocks. The granitic rocks are characteristically jointed. Some of this jointing also affects the basic dikes, as is shown in Fig. 3 by the continuity of some cracks from the dikes into their wall rocks.

MAGNETITE OCCURS IN BOTH GRANITIC AND METAMORPHIC ROCKS

Magnetite aggregations, disseminations, and veinlike bodies are in a zone which strikes roughly northwest in general parallelism with the main belt of metamorphic rocks and near or in its western contact zone. There is no restriction of magnetite to the granitic-metamorphic contacts, but the general areal distribution of the magnetite conforms to the area of penetration and segmentation of the metamorphics by the granitic rocks. Magnetite is in both the granitic and metamorphic rocks. The largest bodies are in the cleavable metamorphic rocks, and it is apparent that this rock type is more favorable for widespread and concentrated magnetite deposition than the granitic rocks. In these metamorphics the magnetite forms irregular disseminations or massive aggregations without limiting fissure walls and apparently without fissure control. Some inclusions of metamorphic rock, within the granitic rocks, have been almost entirely converted into near-ore by thorough disseminations of magnetite, and the surrounding granitic rocks contain but a sparse mineralization. Magnetite in the granitic rocks typically forms veinlets and sparse disseminations. In some cases the granitic rocks contain small massive magnetite bodies, but in no observed instance are there extensive deposits as in the cleavable metamorphics. Important though it be to a full understanding of magnetite genesis, I regret that I have not sufficient data to establish the age of the basic intrusives. They may be post-mineral or nearly contemporaneous with magnetite deposition.

Of the several mineralized loci in the area, only one is of sufficient size and grade to be worthy of consideration as an orebody. This iron orebody has a striking exposure on a precipitous cliff forming the northeast side of the ridge extending northwest from Iron Mountain peak, as shown in Fig. 3. All of the exposed mass above the snow is iron ore, and much of it is nearly

solid magnetite. The length of the exposure is about 500 ft. In Fig. 5 is shown a cross-section of the exposed orebody through the apex of its outcrop. The width of ore shown is about 250 ft. The photograph shows the jagged outline of the outcrop and the talus of magnetite spread over the gentler slopes. Adjoining this ore mass on the left is the metamorphic rock mass appearing in the right foreground of Fig. 1. In the background of Fig. 1, Iron Mountain is shown with the frozen lake (in July) at the base of its extremely precipitous north side. The structure of the metamorphics, accentuated by the erosive action of temperature changes and ice and snow, is brought out in Fig. 1, and for comparison Fig. 4 shows the similar structure of the orebody where it lies in the metamorphics.

The granitic series lies on the right of the ore exposure in Fig. 4, and the orebody for a considerable portion of its length lies close to the granitic rocks but in the metamorphic rocks. The orebody passes into the granitic rocks on both sides of its horizontal extension, so that the statement previously made that the magnetite bodies lie in both the granitic and metamorphic rocks holds. The relative hospitality of the slaty metamorphics and the blocky granitic rocks for ore is shown by the fact that a large mass of ore in the metamorphics narrows and finally peters out in veinlets and sparse disseminations, in the granitic rocks.

Mode of Emplacement Varied

Tracing the development of ore-in-hand specimens, step by step, one finds cases of sparse disseminations of magnetite scattered through the rock, or in clusters, or aligned along planes or zones; other instances of a dense concentration of magnetite interspersed with conspicuous rock substance; and still other examples in which nearly the entire mass is magnetite. When the host rock is slaty, or closely jointed, the original slaty cleavage or joining is frequently found in the ore. Unless the magnetite were deposited during the same crystallization stage as the associated minerals, by direct magmatic segregation *in situ*, such similarity of structure in the host rock and the ore can only mean that replacement—that is the removal of the rock by dissolution and deposition of magnetite in the space provided by this dissolution—operated. Magmatic segregation *in situ* is precluded by the fact that magnetite is found in metamorphic rocks and in granitic rocks which intrude these metamorphics; hence it could not have crystallized during the same stage as the minerals constituting the metamorphic rocks. The preservation of rock structure—the clearest of proofs of replacement—seems to have been made possible by the growth of magnetite from a number of points, indicating a thorough diffusion of magnetite-depositing solutions. Had replacement proceeded invariably with a concerted flowing front, it is doubtful if the ore would have retained the structure of the replaced rock.

Figs. 1 and 4 illustrate on a large scale the preservation of the slaty or closely jointed metamorphic structure. By far the greater portion of the exposure of Fig. 4 is nearly solid magnetite. The structure of this orebody has been made conspicuous by mechanical disintegration, but, as in the case of the metamorphics, this is merely an accentuation of the inherent structure of the body. In this same orebody, when the ore passes into more massive rocks it takes on their massive structure. Other exposures of conspicuously protruding slaty outcrops, impregnated with magnetite, are found in the Iron Mountain area; but, as in the case of the orebody, other magnetite deposits in the granitic rocks have a typical rounded or blocky structure, conforming to the structure of the host rock. Hence any notion that the magnetite might weather in the sharp forms of Fig. 4, irrespective of the host rock, is disproved.

A certain amount of post-mineral movement has effected the magnetite bodies as well as the inclosing rocks. But that magnetite was deposited in the metamorphics after their main structural characteristics had been developed, and therefore that the orebody structure shown in Fig. 4 was inherited from the metamorphics and not produced subsequent to ore deposition, are shown by a number of factors: (1) Magnetite bodies sometimes lie parallel to the slaty cleavage and manifestly occupy this position because of preferential deposition in the direction of easiest penetrability. (2) Magnetite disseminations in the metamorphics do not show deformation commensurate with what would be expected if stresses that produced the slaty cleavage had acted on the magnetite. (3) Relatively massive intrusives cross the metamorphics and their slaty cleavage, and both intrusives and metamorphics are mineralized with magnetite.

In both the metamorphics and the granitic rocks, reticulating or parallel veinlets or veins, formed along fissures, indicate some fissure filling. In the blocky granitic rocks it is especially clear that veinlike masses have followed fissures. In many exposures, however, it is also plain that the original fissure walls have been modified by dissolution. Frequently a dissemination of magnetite outside the veins shows that the depositing solutions wandered away from the fissures. A deposition of some magnetite bodies parallel to the slaty cleavage of the metamorphics indicates that magnetite-depositing solutions preferentially followed planes or zones of easiest penetrability and presumably filled available openings.

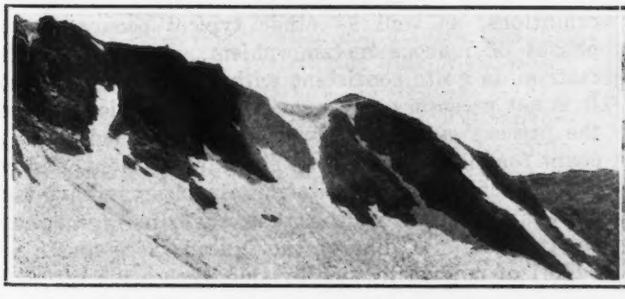


Fig. 3—Cliff exposure of orebody about 500 ft. long

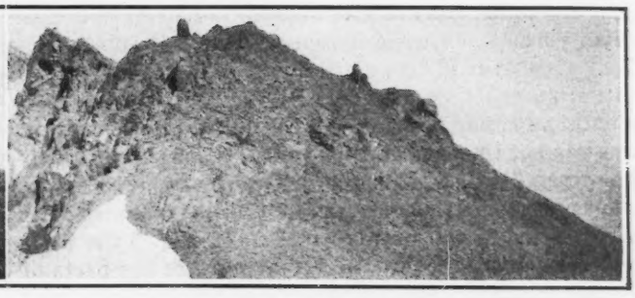


Fig. 4—Apex of orebody
Note the jagged structure and boulder-strewn slope.

The conclusion is that magnetite was emplaced by both space filling and replacement, but that replacement was by far the dominating mechanism. To postulate the formation of magnetite within these dense rocks by

Fig. 5—Photomicrograph of thin section of magnetite ore in metamorphic rock. Magnified 50 X; Black, all magnetite

metasomatic processes or along mere cracks, partings, and interstices, it is necessary to conclude that the depositing solutions were extremely penetrant and must have possessed pressure sufficient to overcome friction and other opposing forces. But of course it does not follow, nor does the field evidence indicate, that these solutions had the power to thrust aside the rocks. In the cases of the larger bodies, the intimate admixture of host rock and magnetite makes this thrusting-aside mechanism inconceivable. For some veinlike masses it may have operated, but I saw no corroborating evidence.

Some petrographers who have examined the thin sections shown in Figs. 5 and 6 and several others consider that the magnetite was probably deposited during the same crystallization stage as the associated rock minerals. True, perhaps, in some instances; but this interpretation, which would imply that magnetite crystallized *in situ* from the igneous solutions which likewise constituted the mother liquor of the contiguous rock minerals, and was not introduced among these minerals after they had crystallized, and from an extraneous source, is not competent to explain magnetite in the metamorphics nor as veins in the granitic rocks. In Fig. 5 the black field is all magnetite and the light patches are parts of the metamorphic rock, adjoining and intermingled with the main orebody (Figs. 1, 3 and 4). I interpret the inclusions as merely replacement residuals of the host rock. The hand specimen, which is mainly magnetite in which the slaty cleavage of the adjoining metamorphic rock is preserved, certainly suggests the phenomenon of replacement.

In Fig. 6 the host rock is granitic. The black patches and veinlike mass are magnetite. The sinuous margins of, minute tongue-like extensions into, and embayment of, the rock, as well as the inclusions of the rock near the contact, suggest some dissolving effect of the magnetite. Granting that this veinlike mass and patches of magnetite were introduced into the rock subsequent to the crystallization of the rock minerals, the insinuating penetrating power of the magnetite-depositing solutions is suggested by this photomicrograph, as it is also by large-scale occurrences. It appears that the relative ease with which magnetite-depositing solutions could penetrate and spread through the rocks was an important factor in determining the concentration of large masses of ore in the slaty rocks, rather than in the blocky or massive ones. I have not sufficient chemical and microscopic evidence to base an opinion on, as to whether replaceability and chemical interactions, in or near limestone, were leading factors in localizing the Iron Mountain magnetite concentration.

Origin Analogous to Other Occurrences in the West

Upon the basis of field evidence, I conclude that these magnetite deposits have originated through processes that have been termed "igneous metamorphism" or, more specifically "contact metamorphism." Their origin appears to be essentially the same as the typical iron-ore occurrences of the western Cordillera, such as those of British Columbia; Shasta County, California; Eagle Mountains, southern California; Iron Springs, southwest Utah; Fierro, N. M.; and many others. In all of these occurrences the magnetite deposits lie near or in igneous rocks, usually of intermediate composition. The inference commonly drawn is that the deposits were formed by direct emanation from these igneous rocks, either from their exposed or underlying portions. The term "contact metamorphism," in so far as it suggests the localization of the magnetite deposits on the contact of the intrusive and intruded rocks, is objectionable, because the magnetite bodies are not restricted to this position. At Iron Mountain, as in most other typical cases, the magnetite bodies are in part found as veinlike or irregular bodies in the intrusives or in the intruded sedimentary, metamorphic, or igneous rocks. Magnetite deposition distinctly subsequent to the solidification of the intrusive, as shown by veining and replacement of the intrusive, is not explained satisfactorily by direct emanation from this exposed intrusive. On the other hand, a broad view of the Iron Mountain conditions, as well as other typical occurrences, as phases of igneous metamorphism or igneous metasomatism, is quite consistent with the facts of the field. It is not necessary to assume that interactions between the present exposed intrusives and intruded rocks account for all the magnetite, since interactions, and possibly differentiations, quite conceivably may have taken place at a lower horizon than the site of magnetite emplacement. A dike of the igneous rock and a vein (dike) of magnetite, side by side, each a discrete body, does not imply that emanations from the dike produced the magnetite vein; but it does suggest that both dike and vein were differentiations from a lower source and

were separately and perhaps independently emplaced. The condition is suggestively analogous to dikes and coarse-grained quartz veins sometimes emplaced in juxtaposition. The whole problem is complex, and in spite of the recognition of the general type no one has yet portrayed a clear picture of the origin and mode of emplacement of these magnetite and other so-called "contact metamorphic" deposits.

Ore Estimates Are Indefinite

Published reports of possible tonnages, which include such statements as "practically unlimited supply," "largest in the West," and "30 million tons practically in sight," are apparently optimistic generalizations, rather than measured estimates. In my judgment the only deposit in the area examined combining sufficient size and grade to constitute an orebody, under present economic conditions, is the main deposit (Figs. 3 and 4). This orebody is exposed through a horizon of about 550 ft. (but not in a vertical line from top to bottom), and for a horizontal distance of about 1,400 ft. Estimating the mass of ore actually exposed along the strike and the cliff section, which cuts the strike diagonally (Fig. 3) through the widths measured on the surface, and to maximum depths somewhat below visible ore along the sides of the body, a figure in the neighborhood of a million tons virtually "in sight" is obtained. Considering the ore to descend throughout its length to the lowest depth visible, which is its most northwesterly outcrop, and to maintain its width shown at the outcrop throughout this depth, rough measurements indicate ore around seven million to ten million tons. Variations depend upon width measurements, which are at present indefinite because of float mantling of ore in place, and also upon the configuration given the lower assumed limit of ore, upon which there is much uncertainty. An assumption of considerable vertical continuity below present exposed lower limits raises the reserve of ore well above the largest figure mentioned. The topography permits easy and rapid testing of the grade and vertical continuity of the ore by a series of bore holes.

Working Methods Not Complex

Many million of tons can be removed through one or more tunnels before sinking would become necessary. Direct attack by open cuts and removal of several million tons is possible with no preliminary development work whatever. No waste overburden is present. More favorable conditions for cheap mining of the surface or near-surface ore would be difficult to find. These factors help to offset the most adverse factor to be met in exploiting the deposit—namely, the long snow season. As Figs. 1 and 3 show, even in early July of some years snow covers portions of the outcrop and surrounding slopes. As open-cut work would be the most economical mining method until considerable depth below the apex of the deposit had been reached, the long snow season would increase mining costs.

The nearest railroad connection to Pacific Coast consuming centers is near Bass Lake, in the west foothills of the Sierra Nevada, an air-line distance of about 30 miles, and a drop in elevation from about 10,500 ft. at the mine to about 3,500 ft. near Bass Lake. The first 3,000 to 4,000 ft. of drop can readily be accomplished by an aërial tram. The cost of constructing a railroad to make the ore available at the Pacific Coast must of course be carefully considered. Elaboration of this problem will not be attempted. Based on present ore "in sight," railroad construction cost to Bass Lake or the vicinity will be excessive, and not justified. A necessary preliminary is a thorough testing of the grade and quantity of ore. Favorable factors are the relative cheapness with which this testing can be accomplished and the very moderate preliminary development expense necessary to mine many millions of tons of ore.

Economic Outlook Will Depend on Power Costs

In common with other iron-ore deposits in California, the incentive to mine the ore near Iron Mountain depends upon the economics of the Pacific Coast iron and steel industry. When steel producers believe the time ripe to establish blast-furnace plants in the Los Angeles or San Francisco metropolitan areas, exploitation of Californian iron ore deposits will follow. The establishment of electric pig-iron furnaces will depend upon power costs, which as yet are not low enough to encourage pig-iron manufacture under existing economic conditions.

If, however, exploration should prove a favorable ore reserve I confidently expect that the Iron Mountain ore will ultimately be used to supply furnaces on the California seacoast.

The Los Angeles area would appear to have the advantage because of comparatively accessible large reserves of iron ore in southern California desert mountains. But San Francisco enjoys a better geographical position for distributing finished steel to central and nor-

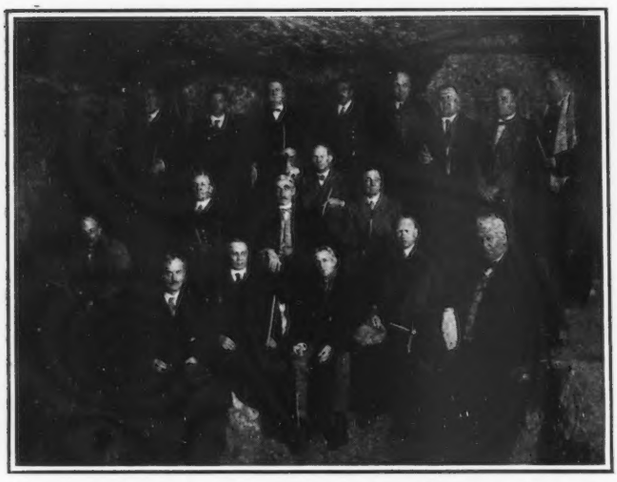
Fig. 6—Photomicrograph of thin section of magnetite in granitic rock. Magnified 50 X; B, balsam; Black, magnetite

thern California and to the west coast of North America north of the southern half of California. Possible railroad distance from Iron Mountain to the San Francisco metropolitan area is 300 miles. Southern California ores are much farther away from San Francisco, Shasta County ores a little nearer and much more accessible, but are relatively small bodies, although they are important auxiliaries to larger reserves from other sources. Iron Mountain ore is the nearest large orebody to the San Francisco area. If a tonnage of something like fifteen to thirty millions of 50 to 60 per cent ore is proven by exploration, which is possible at a very moderate expense, a basis for anticipated use in the San Francisco area will be established.

An Ancient Underground Quarry

Widespread attention to deep mining of marble and limestone indicates that locations for surface operations are increasingly hard to find, and that the quarryman of the future may be forced underground in the search for profitable deposits. Engineers developing such underground operations may find an interesting bibliography in the records of the scribes who chronicled the engineering accomplishments of early civilizations.

As an interesting example, legend records that the Temple of Solomon was built with stone from mammoth



A group of visitors in an ancient underground quarry

tunnel quarries beneath the city of Jerusalem. Solomon's Temple is gone, and other temples built in later years upon its site are gone as well, but the quarries themselves remain as a permanent record of the skill and enterprise of the Hebrew quarryman of 3,000 years ago. These ancient quarries have long gone unworked. Iron gates now close the tunnel entrances, and the only activity is the tourist traffic and the sale of curios carved from fragments of the stone. The operations extended nearly 700 ft. under the city, the quarry roof being supported by natural pillars. The formation is curiously soft and "soapy" before quarrying, when it may readily be carved with a pocket knife. Exposure to air and sun, however, hardens and whitens the stone.

There is little doubt that the great foundation stones of the Tower of David, visible today, and the walls of the temples that used to stand on Mount Moriah, were taken from this underground stone mine. Modern developments of "room-and-pillar" mining thus seem to have a background extending to the tenth century B.C.

Aluminum Industry Growing in Italy

The existence of bauxite in Italy was first called to public attention about twenty-five years ago, when the exploitation of deposits located in the territory known as Lecce ne Marsi, in the Abruzzi, was begun. Its value attracted the interest of industrialists, and in 1905 the Italian Aluminum Co. installed at Bussi a factory for the treatment of bauxite by the Bayer process. During the war, according to *Commerce Reports*, the consumption of aluminum increased until its importation in bars, which amounted to less than 500 metric tons in 1913, reached 4,000 tons in 1917. To increase production the Aluminum company constructed at Villeneuve, in the Valley of Aosta, a factory for the electrolytic treatment of raw materials brought from France. During this period bauxite was found in other parts of the Apennines, and the annexation of Istria gave additional deposits, more important than any others in the Peninsula.

Only part of the bauxite of domestic production is used by local aluminum manufacturers, although the Aluminum company in 1921 opened at Borgofranco a factory of larger capacity than the one at Villeneuve. Part of the bauxite extracted in central Italy is used in the preparation of aluminum salts, but the output from the Istrian deposits is exported almost entirely to Germany, because of the scarcity of electric power and absence of coal for local manufacture. The use of coal from the neighboring Arsa mines and the obtaining of cheap electric power, however, are under consideration, and the Ministry of National Economy has regulated the production and exportation of the ore. The Montecatini company expects to use Istrian bauxite and power derived from artificial lakes constructed upon the plateau of Sila in two projected factories at Cotrone, in Calabria—one for the production of aluminum and one for the preparation of aluminum salts. An exhaustive study of the aluminum industry, furthermore, is being conducted by the Superior Council of National Economy. Italian bauxite and aluminum production, in metric tons, follows:

Italian Bauxite and Aluminum Production

	Bauxite				
Year	Abruzzi	Compania	Istria	Total	Aluminum
1920	3,300	3,339	6,500	13,139	1,238
1921	.....	3,123	46,000	49,123	744
1922	750	6,896	5,930	13,576	800
1923	3,805	2,873	98,317	104,995	1,473
1924	14,200	1,000	125,000	140,700	2,058
1925	10,500	(a)	184,500	195,000	3,000

(a) Unknown.

In 1925 the country imported 6,694 tons of aluminum and its alloys, valued at approximately 97,000,000 lire. During the first half of 1926 these imports totaled 2,286 tons, valued at about 33,000,000 lire. The importation of aluminum cords and cables also is increasing. There is no import tax on bauxite in Italy, but aluminum in ingots and scraps is taxed at the rate of 42 gold lire per quintal. (The gold lire is worth approximately $0.20, whereas, the paper lire fluctuates in value, exchanging ordinarily at about 24 to the United States dollar.)

Prices for the 1925 production of bauxite averaged 72.35 lire per quintal for Roman and 85 lire for Istrian.

Four proprietors are listed as owning bauxite-producing mines in the Rome district of Italy. The following important mines are recorded for other districts: Miniere Clelia, Pola, Istria; Miniere di Monte Mutri, Benevento; Miniere Faicchio, Benevento; Carovenzi, Caserta; and Maiorana & Castelli, Dragoni, Caserta.

Discussion

Bauxite—Its Supply and Manner of Formation

THE EDITOR:

Sir—The leading editorial in your issue of April 9 suggests several interesting possibilities. In the first place, the impression given is that the supply of material from which aluminum can be economically manufactured is unlimited. Although a large number of processes have been devised and patents granted for making alumina from kaolin and other silicates, it is doubtful if any of them can produce alumina as cheaply as it is made at present. The mineral bauxite is, therefore, a necessity for economic production.

There are undoubtedly large deposits of bauxite distributed through the torrid and near-by parts of the temperate zones, but here again production depends upon economic conditions, principally the cost of transportation. Deposits already known and located near tidewater probably contain even at the present increasing rate of consumption a hundred years' supply. However, these deposits are nearly if not all actually controlled by the large interests now manufacturing metal. Large deposits out of reach of economic transportation cannot be considered in the present or near future by an independent consumer when bauxite is sold c.i.f. New York at $6 per ton. It is quite improbable, however, that any large quantity of ore fit for the production of metal could be bought for the manufacture of metal at this price.

Tropical climatic conditions seem to be necessary for the formation of bauxite, and known deposits are apparently of recent geological origin, having been formed since the Cretaceous period. There are several explanations why the feldspar fraction of pegmatite dikes decompose in temperate latitudes to kaolin and in the tropics under favorable conditions to bauxite. It is my opinion that the kaolin is not always an intermediate stage—in other words, that the decomposing rock forms either bauxite or kaolin, according to conditions. An examination of the bauxite deposits in both British and Dutch Guiana even suggests that they may be of sedimentary origin and that aluminum hydrate has been precipitated from the waters of lakes or lagoons by a chemical change brought about by fresh-water streams flowing into brackish bodies of water along the coast.

The phenomenon mentioned in *Bulletin No. 1* of the Gold Coast Geological Survey regarding elongated pieces of the yellow bauxite occurring in the clay beneath the solid bauxite has been observed by me in several bauxite deposits in Dutch Guiana. These pipes occur in the form of fingers, frequently terminating in bulbs reaching down from the body of ore above. However, the line of demarkation between the bauxite and kaolin is usually quite distinct except for a few pebbles of bauxite just below the line of contact. Is it not quite possible that these bodies of hydrated aluminum oxide, which are very pure, are secondary enrichments due to the leaching of the bauxite above? Their form even suggests that they may have been deposited in root cavities, which could be explained by an interruption in time of deposition, which allowed a growth of vegetation over the top of the clay deposit before the laying down of bauxite. A close examination of these so-termed roots shows that they are built up like a stalactite in concentric layers, only in a reverse order, the surface being quite hard and smooth, the interior soft and frequently not completely filled. Remnants of organic matter were also observed in some of the cores.

Bauxite deposits, in common with the formations of other minerals, probably have several origins. At least three distinct types are recognizable in different parts of the world.

LLOYD T. EMORY.

Philadelphia, Pa.

A Feldspar-Chalcopyrite Rock-Ore

THE EDITOR:

Sir—Regarding Prof. R. J. Colony's article entitled "A Feldspar-Chalcopyrite Rock-Ore," which appeared in the April 9 issue of *E. & M. J.*, it seems to me that his conclusions regarding the magmatic origin of the sulphide minerals are open to question on the evidence submitted in the same article.

According to Professor Colony, the sulphides pyrite, chalcopyrite, and bornite are intimately associated with quartz, epidote, zoisite, albite, and chlorite, which, altogether, form an end-stage crystallization residuum of the magma. In comment on this conclusion, it seems fair to mention that in most standard works on petrography, the minerals epidote, zoisite, and chlorite (and frequently also the soda plagioclase albite) are described as secondary, being the result of deep-seated or hypogene alterative of the original soda lime plagioclase and ferromagnesian constituents of the rocks in which they are found.

Professor Colony says that "Epidote forms margins around sulphide grains in places, and very frequently occupies tiny irregular veinlets in the feldspar: some of the feldspars show a streaky interior albitization as well as a development of albitic margins." Two of the photographs submitted (Figs. 2 and 6) show this very clearly, Fig. 2 being a veinlet of epidote with associated chalcopyrite, and Fig. 6 showing bornite and chalcopyrite rimmed with epidote. In view of this evidence and the generally accepted secondary origin of epidote, it seems reasonable to assume that the associated sulphides have a like origin and were introduced into the rock by a process of replacement subsequent to its crystallization.

I may remark in this connection that a number of years ago I had occasion to examine a granite or monzonite which, on megascopic inspection, appeared to have original chalcopyrite. A microscopic examination, however, showed that in all cases the chalcopyrite was intimately associated with sericite, and the magmatic theory of its origin was abandoned.

Toronto, Ont. J. A. REID.

Results With the Magnetometer

THE EDITOR:

Sir—Pertinent to your editorial respecting the matter of the "Dowsing Rod or Doodle Bug," and the experience of the persons mentioned as reported in the Cornish paper to which you refer, I recall a recent letter that I addressed to the *Nevada State Journal*, at Reno. In this letter I told how in Churchill County some eighteen years ago I did some work with the Thieberg-Thalen magnetometer. We were driving a long tunnel and were due to cut a vein exposed upon the surface and which had a course at right angles almost to that of the direction of the exploration tunnel. This vein was a wide one, well defined on the surface, and "apparently" had a dip of 35 deg. to the north or toward the portal of the tunnel. When we found that the vein was not where it was expected to be, but that in its place was a formation of sedimentary rock identifiable with a sedimentary rock about a thousand feet closer to the portal of the tunnel than the vein, as such was exposed on the surface, we "wondered" what had taken place. Hence the desire for additional information which prompted the use of the instrument. When this instrument arrived, I found that all of my knowledge of magnets, of geology and of various things pertaining to engineering was not enough to enable me to clearly comprehend all that was bundled up and concentrated in the two projecting arms, the two magnets set in place, and the iron weights accompanying. After a time I finally got the machine together and was ready for the proposed trial, all the while having a feeling that I was wrestling with something, as far as I was concerned, that was "intangible," but I took a chance. In fact, I was at that time ready to consider almost anything. Had somebody come along with a "witch stick" he might have found me ready for considering it. We were some 700 or 800 ft. beyond where we should have cut this vein and yet the blamed thing would not put in its appearance, so in desperation I set out with the paraphernalia, not at all sure that all the screws and nuts were in the right place, and set it up a few feet back of the face of the tunnel. In a few moments of readjusting and fumbling with this unknown agent, I could see that it was "working"—that is, the instrument was at work, but so far as I could see it was not working right, inasmuch as it read that we should drift at a right angle to the direction of the tunnel westward. I was ready to kick it out; in fact I really did lay it aside and decide that we should follow the course originally laid out and keep on in that direction, for surely the instrument was unreliable. In about 500 ft. or so we cut the vein and its course was eastward as on the surface. When we drifted westward on it, we found to our astonishment that the vein turned sharply northward. If I had respected the dictates of that instrument we would have cut the vein within 200 or 300 ft. and thus have saved considerable drifting.

The article referred to expresses my sentiments regarding the magnetometer and as to its being adaptable for locating magnetic veins where they are of any magnitude. In this particular instance, we cut the vein mentioned about a thousand feet beneath the lowest point where it apexed on the surface, so, to say the least, the instrument might have proven most useful had we made use of it considerably earlier and obeyed its dictation. JOHN T. REID.

Lovelock, Nev.

Financing the Atlantic Cable

THE EDITOR:

Sir—In that interesting article by Mr. Dwight E. Woodbridge, in your issue of March 5, he states that the old Lamanche mine helped greatly in financing the first Atlantic cable. This is correct, and a few extracts from the diaries of my father, the late Harry T. Verran, M.E., may be of interest in connection with the great service which this old mine rendered the world.

My father came from England with Major R. S. Ripley, in 1857, to take charge of developing Lamanche mine; after an examination he proceeded to New York, and came back to the mine in April, 1858, accompanied by Ripley and by Mr. David Dudley Field, brother of Mr. Cyrus Field, promotor of the cable enterprise. In July of that year a steamer arrived at Lamanche for a cargo of lead-silver ore, bringing orders to my father to stop sinking and to raise ore for shipment; and, although the mine was not deep enough, Major Ripley demanded ore at once, and said "take it out wherever it can be had." In stoping, my father ran into a cavern carrying large quantities of lead, but very dangerous to produce without more preparation, owing to the great masses of heavy ore hanging in all shapes. My father felt compelled to resign, as he told Major Ripley that he "did not come to Newfoundland to dig graves for miners."

In his report on the property, made before going to New York, my father stated that "the indications of highly charged metalliferous lodes would, in Cornwall, present sufficient incentive for the display of energetic enterprise and a sufficient supply of funds." It was on this report and its recommendations that the mine was developed, and my father's suggestions as to manner of development and machinery were followed for a time.

Profits from the ores mined and from the sale of stock were used to complete the cable.

Placentia, Newfoundland. HENRY VERRAN.

Amparo's Labor Difficulties Exaggerated

THE EDITOR:

Sir—In the mining news of the issue of April 2, on page 582, it is stated that "the union miners at the Amparo (in Jalisco, Mexico) have taken over the operations of the mine on their own account, leaving the mill in the hands of the company."

We were quite surprised to read this notice and we also have received letters from the States asking us in regard to it. The statement is entirely false, and is calculated not only to cause us serious difficulties but is also prejudicial to the interest of this company. We are at a loss to understand why statements should be thus made by irresponsible persons who evidently do not take the trouble to verify what they print.

You may be aware that labor troubles are difficult enough in any case without statements being made which may cause us to be accused of making false complaints by government officials, and the reading by our stockholders of such a notice will certainly cause us serious injury. It is true that in company with all industries in this state we are experiencing our difficulties with labor, due, not so much to the workmen as to agitators from outside, but nothing approaching what is printed in this article. JAMES H. HOWARD.

General Manager, Amparo Mining Co.

Etzatlan, Jalisco.

News of the Week

Summary

THE CORE from U. S. Bureau of Mines potash Well No. 1, located in Eddy County, N. M., proves to be commercially disappointing.

Anaconda announces that construction will soon be started on the electrolytic zinc plant at Anaconda, Mont. The plant will have a capacity of 150 tons of metallic zinc per day and 10,000,000 lb. of ingot zinc per month.

Mineral production of Mexico was practically the same for the last four months of 1926 and the first four months of this year. A recent slight decrease in operations was reported for the smaller camps, but this was compensated by increased production at the larger mines.

By unanimous decision of the Supreme Court of Canada the mineral rights of the lands formerly held by Hudson's Bay Company are the property of the Crown.

Weepah settles down to business, and the town population dwindles to 600.

A virgin gold field is reported in northern Natal, South Africa. Alluvial tin claims are being staked at Jamestown, and asbestos claims at Devil's Kantoor.

The St. Louis Smelting & Refining Co. is said to have optioned 1,800 acres in the Sudbury district, near the Bunker Hill & Sullivan options.

East Geduld Mines, of the Union Corporation, states in its first report that a large tonnage of ore above the average value of the parent and adjoining property, Geduld Proprietary Mines, has been indicated.

The United States Circuit Court of Appeals affirms the decision of the District Court of the United States for the District of Maryland to the effect that the process of the Minerals Separation North American Corporation does not infringe that of the Wolf Mineral Process Corporation.

A new gold rush is reported in the Kofa district, Arizona, about 75 miles northeast of Yuma in the vicinity of the Colorado River.

Lower Court Opinion Affirmed in Flotation Suit

The United States Circuit Court of Appeals Finds No Infringement by Minerals Separation Corporation of Wolf Mineral Process Corporation Patent

IN A SUIT instituted by the Wolf Mineral Process Corporation the United States Circuit Court of Appeals decided on April 12 that patent 787,814, held by this corporation, had not been infringed by the defendant, the Minerals Separation North American Corporation. Excerpts from the full text of the opinion of the court follow:

"All of these facts, with the other circumstances of the case, were carefully weighed and considered by the learned district judge, as shown by his well-reasoned opinion, at the conclusion of which he states: 'Careful consideration of the evidence requires the finding that . . . the charge of fraud on the part of the defendant, and the claim of equitable ownership by Wolf and the plaintiff of the patent of the defendant, is without foundation.'

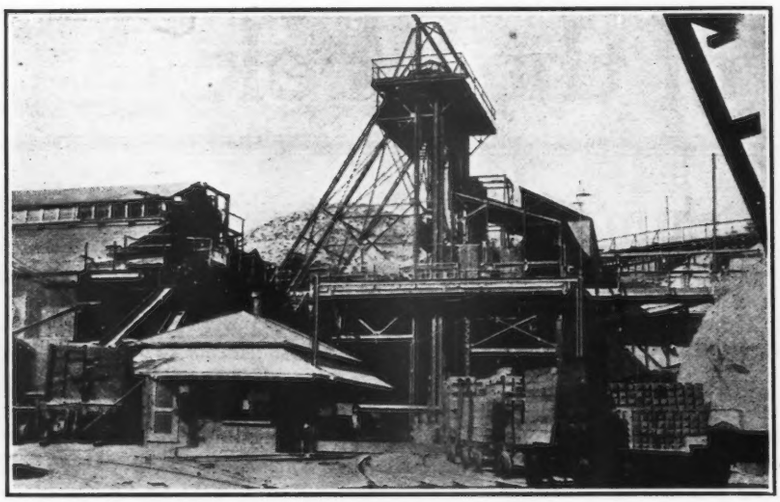
"As this is an appeal in equity, we are not bound by the trial judge's findings of fact, as we would be upon a writ of error; but the rule is well settled that, as he has seen and heard the witnesses, his findings ought not be disturbed unless it clearly appears that he has misapprehended the evidence or has gone against the clear weight thereof, or, in other words, unless we are satisfied that his findings were clearly wrong. . . . We have carefully considered the evidence in the light of the briefs and arguments, and we find nothing which would warrant us in reversing the finding of the district judge. On the contrary we are of opinion that his finding was right. Wolf's process was a bulk oil flotation process; that of defendant was a froth flotation process. Wolf's patent utilizes the lifting power of oil due to its having a lower specific gravity than water. Defendant's patent utilizes the buoyancy of air, the oil used being practically lost in the process. Wolf used violent agitation to bring the particles of oil into contact with the metal particles, so that it might lift them to the surface; defendant's patent uses violent agitation to beat air into the mixture, so that a froth of bubbles will be produced.

"It is perfectly clear, however, that the processes pursued by the licensees of defendant are entirely different from the processes of the Wolf patent. As heretofore stated, that process covers an oil-buoyancy process. Agitation of a violent character is resorted to in order that the particles of oil may be brought in contact with the particles of metal, and especially with those included in the slimes, so that when the oil floats to the surface it will bear these metal particles with it. The fact that the oil takes up some of the gangue is not a desirable element of the process, but is incidental to the violent agitation necessary to bring the particles of oil in contact with the metal. The essential difference between this process and the froth-flotation process of defendant's patent has already been adverted to. The fact that some gangue is taken up by the froth of the froth-flotation process does not constitute it an infringement of an oil-buoyancy process in which gangue is also taken up, and calling the violent agitation, which causes the gangue to be taken up 'overtreatment,' does not change the matter.

"As to infringement in 'retreatment,' it must be apparent that the re-agitation of mineral-bearing froth is essentially different from passing thin streams of mineral-bearing oil through hot water, so that the oil will be thinned and the gangue dropped therefrom. In the one case, we have a mere repetition of the process of defendant's patent, which admittedly does not infringe the Wolf patent; in the other case we have a mere thinning of the mineral-bearing oil by the application of heat, with the result that it drops the gangue which it held while more viscous."

Duthie Mines to Install Flotation Plant

The Duthie mine, a lead-silver-zinc property at Smithers, B. C., has been under development for about three years, during which time approximately 7,000 tons of lead-silver ore has been shipped to Trail and to Selby. Recently a contract was awarded for a complete 50-ton flotation mill, which will be operated as a pilot mill. The plant is to be subsequently enlarged by additional units to 300 tons per day capacity.



Principal working shaft of the Old Dominion mine, Globe, Ariz.

Old Dominion Mines Lower-Grade Ores

The Old Dominion mine at Globe, Ariz., reports that, although the tonnage of ore mined in 1926 exceeded that of the previous year, the production of fine copper was less. Lower tonnage of direct smelting ore, and a decrease in the grade of both the smelting and concentrating ores, were responsible for the drop in fine copper production. Improvements which the company has made in the metallurgical processes used permit the mining of a lower grade of ore than was formerly considered commercial.

Weepah Settles Down to Business

The new gold camp of Weepah, 37 miles from Tonopah, Nev., appears to be settling into a business stride. During the latter part of April many claim groups were sold, an indication that development work will soon be started at widely separated points. Many new companies have been incorporated during the last month, but the major portion of the close-in ground is held by old companies which originated during the Tonopah Divide boom of 1918-1919.

At the property of the Electric Gold Mines Co., in which the high-grade gold strike was made, fifteen men are employed. Favorable gold showings have been encountered and some lead-silver-gold ore has been opened on the 100 level. The south crosscut, which has for its objective the downward extension of the high-grade gold surface strike, has several hundred feet to go to reach the projected position. No work has been done on the high-grade strike itself. Several leasers have started work on small blocks.

The town probably does not contain over 600 people at the present time. There are about 100 men employed in the various prospective mines of the district and about 100 additional prospecting in the vicinity of Weepah. Several lead-silver strikes, of unknown value, have been made in the Lone Mountain section, which includes the Weepah district.

Current Alaska Operations

Fairbanks Exploration Resumes Construction at Fairbanks

W. J. Elmendorff, of Seattle, consulting engineer for Kassan Gold Co., operating on Prince of Wales Island, reports that milling operations of about fifty tons a day will be started soon. Development of the Titan, on Fish Creek, is proceeding under contract. The tunnel shows a full face of milling ore.

The Fern Mine, at Willow River, will resume crushing next month. A new oreshoot 6 ft. wide has been struck in a raise on Talkeetna ground, and is being developed by drifts. Values are stated to run from $20 to $80 per ton. The Marion Twin Mining Co., which has been financed at Los Angeles, is placing a 35-ton rod mill on its property. The Mabel Mine, under bond to Horning and Bartholf, is being successfully developed, and a considerable tonnage of gold-quartz carrying high values has been proved up. Willow Creek Mines Co., operating the War Baby and Lucky Shot, expects to make an important gold production this season. Gold Cord is under development.

At Chulitna the Homestake is being developed by an Anchorage syndicate. The Moose Mining Co. is developing the Mint Ruby by a shaft which it is proposed to sink 300 ft. on a vein varying in width from 8 ft. to 16 ft. The mine is 9 miles from the Alaska Railway.

Alaska Hills Gold Mining Co. is resuming development of its gold-quartz mine at Nuka Bay. The mine is being equipped with an oil engine and compressor.

Fairbanks Exploration Co. has resumed construction of its power house on Garden Island at Fairbanks. The company expects to complete all its construction work this year with the exception of the Scrafford tunnel. The cost of the power house is placed at $1,500,000. A force of 300 men, employed during the past winter, is being increased to about 1,000. The local labor supply is ample to meet requirements. The Chatanika ditch is 85 miles in length, and is being linked up by siphon pipe aggregating 6 miles in length. A start has been made on construction of these siphons. The main dam, electrical transmission lines and machine shop will be constructed this summer. The first two dredges of the company's fleet will be delivered this fall and transported to the scene of operations during the winter months, one being placed at Goldstream and the other at Cleary, where substations for power distribution will be built. The dredges are being constructed by the Union Iron Works of San Francisco, at a cost of approximately $500,000 each. It is proposed to install nine dredges in all, making the world's largest placer operation. The recoverable gold in the company's holdings is estimated at $128,000,000.

The Cleary Hill Alaska Mines Co., which is composed of Fairbanks and Minneapolis men, is actively developing the Rhodes-Hall gold-quartz and other lode mining properties. These have produced gold to the value of over $1,000,000. The quartz averages $50 to $60 a ton. Rhodes-Hall mine is well equipped with a 5-stamp mill, hydroelectric power, compressor, and hoisting and pumping machinery. The mine is distant 25 miles from Fairbanks and four miles from Chatanika. Whitworth Syndicate, of Manchester, England, is taking up its options on Engineer Creek and will install there another dredge in addition to the one being operated by the syndicate on Fish Creek. Long Creek is being tested by drilling to ascertain its prospective value for dredging. The Nome Creek Dredging Co., organized and financed in Fairbanks, is working a channel 170 ft. wide, carrying an average depth of 10 ft. of pay gravel. Last season it handled about 80,000 cu.yd. of gravel of an average value of 50c. A new dredging area is Camp Creek, where testing of the gravels is stated to have given an average value of $1.50 per cubic yard. Orn & Co. and C. M. Lockhart have taken out large dumps on lower Fairbanks Creek.

A new beach discovery is reported from Nome. On Inmachuck Creek, north of Nome, test shafts are being put down through the lava beds to ascertain whether these cover old channels of pay ground.

General Petroleum continues drilling for oil at Yakutat. The Peterson Oil Co. proposes resuming drilling at Chickaloon, Cook Inlet.

Cripple Creek Mines Reopen

The Morning Glory and the Doctor Jack Pot mines near Cripple Creek, Colo., will be opened soon, according to C. P. Heckler, lessee of the properties.

Nickoli and Benson, who made the sensational find in the Plutocrat, announce that the ore continues to be of the same high grade. Machinery to sink a 100-ft. shaft has been ordered. The Orpha May and the Los Angeles mines of the Stratton estate will be reopened for extensive development work as soon as the surface equipment has been overhauled. The upper levels of both properties will be opened to sublessees by the Stratton company.

Cripple Creek production for March was 43,223 tons valued at $403,311.

Michigan Copper Country Properties Active

Mohawk at Peak Production—Deep Level Hoist Installation at No. 7 Hecla Shaft

Calumet & Hecla Consolidated has started preliminary work at the old Phoenix mine, in Keweenaw County, Mich., preparatory to reopening the property for exploratory purposes. This is part of the exploratory program the company has started at the old Cliff mine. The Crocker shaft, at the Phoenix, will be unwatered. It is a vertical shaft, 780 ft. in depth. The property was a profitable producer in the 70's, when considerable copper was recovered from fissure veins. It also was quite rich in silver. The property is believed to have possibilities on the Ashbed and other amygdaloid beds. Encouraging cores were obtained when the Ashbed was tested by diamond drills for a distance of 2,700 ft. along the vein. When Phoenix was reorganized, in 1899, it was planned to unwater the Crocker shaft, but the work was not carried out, operations being confined to the West vein on the old St. Clair property.

The conglomerate tailing from the first stamp mill of Calumet & Hecla Consolidated, which was located at Calumet, will be re-treated at the company's Lake Linden reclamation plant.

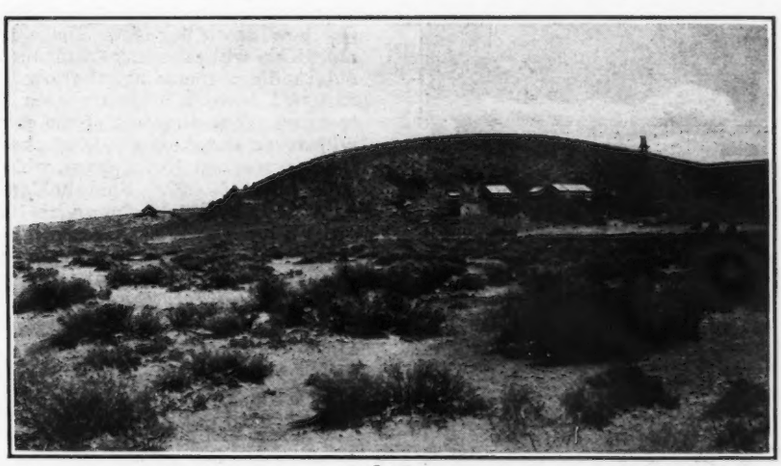
In order that the good showing in the north section of the 12th or bottom level of Arcadian Consolidated's New Baltic shaft may be further tested as to its continuity, a raise will be started from the 11th up toward the 9th level drift, where copper values have already been proven. It is expected that the "shoot" of copper ground may show good mineralization between these two levels. In addition to this work, a crosscut running east from the 12th level will be continued for some 250 ft. for the purpose of tapping No. 8 conglomerate, which was found to carry values when disclosed from the 750 ft. level of the New Arcadian shaft. No. 8 conglomerate is a strong and well-defined vein, and its development would be of interest to the entire Lake Superior district, as this formation is known to traverse practically the whole copper country mineral belt.

The Smuggler Union mine located above Telluride in the San Juan region of Colorado

Mayflower-Old Colony will continue its north drift until the character of the vein encountered in the 1,700 level crosscut is established. The lode still is well defined and of good width, but its copper values are not commercial.

It is expected that the electric hoist of Calumet & Hecla Consolidated on the 80th level of No. 7 Hecla shaft will be ready for operation within a month. This shaft will be the only one in the Hecla branch of the mine to operate below the 81st level haulageway; the purpose of the installation is to effect economies in deep mining. A similar situation will exist in No. 4 Calumet shaft, where the foundations have been built for an electric hoist at the 78th level. It probably will be the fall of the year before this hoist is in operation.

Production of the Mohawk mine is at the highest rate in the history of the property. More that 2,000,000 lb. of refined copper was produced in March, and it is understood that the output in April will be almost as great. Widening of the vein in No. 6 shaft and the richness of the rock are largely responsible for this increase. The lode in many places is 30 ft. wide, as against a normal width of 12 ft.



Site of operations of the San Rafael Development Co. in the Quartz Mountain district, Nye County, Nev.

Smuggler Union Mine Has Excellent Record

According to the last available report, the Smuggler mine of the Smuggler Union Mining Co. at Telluride, Colo., was employing a force of 300 men and mining 19,000 tons of ore per month, from which 2,000 tons of concentrates were being shipped to the company's smelter at Durango. Encouraging results, it is understood, have been obtained in the development work on the 13th level. The mine, with a production record of more than fifty millions of dollars in gold and silver, continues to increase its record, despite the fact that at various times it has been reported to be about exhausted.

New Motion Picture—"The Story of the Electric Detonator"

"The Story of the Electric Detonator" is depicted in a new educational motion-picture film just completed by the U. S. Bureau of Mines, in co-operation with one of the large explosives manufacturing concerns. The film shows in graphic detail the methods of manufacture and use of this modern and highly practical device for the firing of explosives. This film is now available for exhibition. No charge is made for the loan of the film, the exhibitor being asked only to defray transportation charges. Copies of the film may be obtained by addressing the U. S. Bureau of Mines Experiment Station, Pittsburgh, Pa.

New Orebody Developed in the Quartz Mountain District

The San Rafael Development Co. has, according to report, developed a new orebody on the 200 level above the Lease vein. The ledge has been prospected by a raise and crosscut from the main 200 level, and is being sought on the 250-ft. horizon. It is said by the management that the deposit is showing good indications of persisting to depth.

Tonopah Gold-Silver Bullion for March Valued at $142,700

West End Extension in Good Ore—Tonopah Extension Preparing for Larger Production

The value of gold-silver bullion shipped from the Tonopah, Nev., mining district for March was $142,700. Of this total the Tonopah Mining Co. shipped $74,200, which includes its own and Tonopah Belmont production and some custom ore. West End shipped $35,000, and Tonopah Extension $33,500.

Improvement in underground conditions is reported in the property of the West End Extension Mining Co., in the southwest part of the district. Stoping is being carried on in the vicinity of the 800 level on from 6 to 12 ft. of ore. The West drift on the 900 level has been in ore for 60 ft., and the face now shows 6 ft. of ore of better than mill grade. The drift just started on the 1,000 level, which will cut the oreshoot about 130 ft. below the 900 level measured on the dip of the vein, shows more than 7 ft. of solid quartz containing small values, with neither wall of the vein in sight. Important developments are looked for on the 1,000 level almost any day, and this work is being watched closely by those interested in the future of Tonopah. West End Extension Co. has recently purchased a group of three claims in the Weepah district on which there are prominent quartz outcrops. Preliminary surface work has been started on the claims.

Tonopah Extension continues development to the west on three veins, the Merten, Paymaster, and Bermuda. Stopes are being prepared for larger production in the near future and electric haulage has been extended from the Victor shaft to handle this additional tonnage.

It is reported that the Flowery Mines Co., operating what has been known as the Berry and Lady Bryan properties in Six Mile Canyon, about 6 miles easterly from Virginia City, Nev., has developed high-grade gold ore in the recently acquired Lady Bryan property.

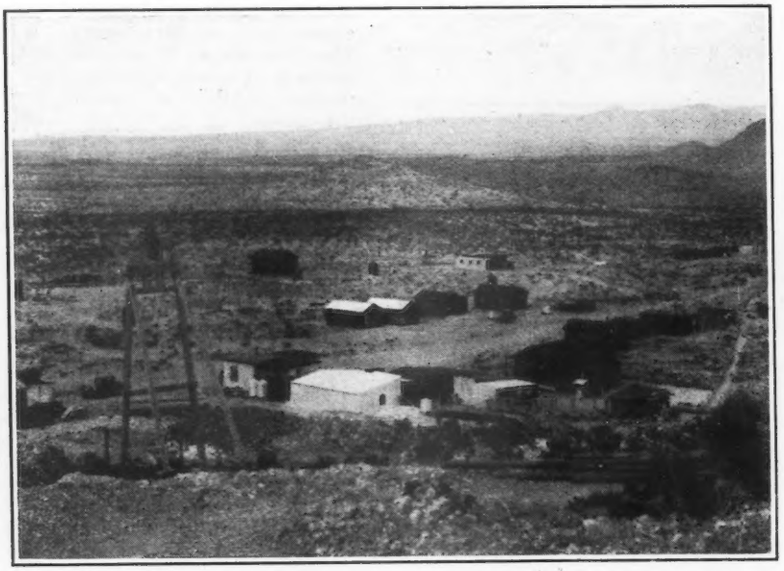
Dunkirk Claims in Prescott District Sold

The purchase of a group of claims known as the Davis Dunkirk group, owned by the Lookout Copper and the Castle Copper companies, and also the Poverty claim, owned by Mrs. Beryl Freeman and Mrs. Wallace, are reported from the Prescott district, in Arizona. The location of the claims is in the Slate Creek and Hassayampa regions. The purchase price of the Davis Dunkirk group is said to have been $20,000. Several thousand dollars additional are reported to have been paid for the Poverty claim. Approximately 6,000 ft. of tunnels and drifts are said to have been put through on the property; the erection of a mill to handle the ore is planned for the summer.

Lead Mines Near Lordsburg, N. M., to Be Developed

After eleven years of careful exploration, A. T. McGhee & Co. have begun intensive development of their Carbonate Hill mines, on the crest and eastern slope of the Peloncillo Range, 23 miles southwest of Lordsburg, Hidalgo County, N. M. The Southwestern Engineering Co. is erecting a 100-ton concentration and flotation mill on the property. This mill, the first unit of a proposed plant of 600 tons' capacity, is to be in operation by June 17. The ore on the property contains lead, silver, zinc and gold values of about $2 a ton.

About 8,000 ft. of development work has been done in shafts, drifts, stopes, and crosscuts. The shaft is down 300 ft. A 240-ft. tunnel has been driven into the hillside 225 ft. below the top of the ore outcrops. The property consists of thirty-one consolidated claims, which were acquired in 1915 by the present operating company. According to present plans, the mill will be supplied with ore from both the shaft and the tunnel. The shipping point is at Steins, 6 miles distant.



View of Carbonate Hill camp in Hidalgo County near Lordsburg, N. M.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Canadian Associated Goldfields Puts Mill Into Operation at Larder Lake

After twenty years the Canadian Associated Goldfields, of Larder Lake, has at last put a mill in operation. The mill has a capacity of about 200 tons a day, although the mill building is sufficiently large to house machinery for a capacity of 600 tons a day. This company has had a long and, from a shareholder's point of view, an unfortunate history. The original company was incorporated many years ago to take up a large acreage in the Larder Lake field. The ore was of low grade, but the company had the idea that it could mill very large tonnages at a profit. Eventually this conclusion had to be abandoned. At a time when it appeared that the fortunes of the company were at its lowest ebb, it acquired, for $6,000, a claim adjoining that of the Crown Reserve Co. on Larder Lake. This has been worked for several years and development carried to the 1,000 level. Not a great deal is known about the mine, but the officials claim that, in addition to a considerable quantity of medium-grade ore, there is a narrow section of ore which would average $50 to the ton, and they state mining will be carried over widths of 6 to 30 ft. of an estimated average of $10. The company has passed through a number of reorganizations. At present it has a capital of $30,000,000, of which approximately $22,000,000 has been issued.

The special shareholders' meeting of the Consolidated West Dome Lake Mines, of Porcupine, will be held in Toronto on May 10, at which meeting a plan will be presented by the directors to overcome the present difficulties of the company and to take care of the excess issuance of stock, which apparently is of serious proportions. The present company has an authorized capital of 5,000,000 shares, and there is an over-issue of approximately 2,000,000 shares. It is proposed to form a new company with a capital of 7,000,000 shares, and issue one share of the new stock for each share of the old. This will take care of all the stock outstanding, including the over-issue, and will leave 3,500,000 shares in the treasury. The directors of the company will agree to take up 667,000 shares of the new stock at 15c. a share, which will bring in $100,000. Shareholders will be offered 1,500,000 shares at 10c. If all this stock is taken up it will net the company $250,000. Present liabilities amount to $50,000, so that the company will be financed to the extent of $200,000 and have 1,333,000 shares in the treasury.

The annual report of the Laval-Quebec Mines for 1926 shows that during that year $43,400 was spent on development and head-office expenses; expenditures for plant, buildings, and equipment amounted to $37,000. The balance sheet shows cash on hand of

$140,000, with practically no liabilities. During the year a total of 37 miles of co-ordinate lines were surveyed and cut at 400 ft. intervals to facilitate geological mapping and prospecting; a total of 8,330 ft. of stripping, trenching, and blasting was done.

Returns from the carload of ore recently shipped from the Potterdoal mine, in Munro Township, shows a return of $41 a ton; copper ran 15.2 per cent; zinc, 4.4 per cent; silver, 2.7 oz.; and gold, 0.045 oz. An electrical survey is being carried on at the property.

The general situation at the Cobalt mine is in line with expectations expressed in previous reports—that new discoveries are not likely to be of major importance and that stoping operations are becoming more restricted and laborious; and, further, that the gradual depletion of high-grade ore makes it increasingly difficult to maintain a regular production. The chief hope for the future appears to lie in Quebec, where the company has a group of promising properties in Montbray Township. At the annual meeting officials were not prepared to make definite statements regarding this property, but it is known that several lenses have been found carrying high-grade gold-copper ore. Several exposures show 3 ft. of 10 per cent copper and $10 in gold, and it is known that diamond-drilling results have shown gold values up to $100. Values, however, have been very irregular, and the company cannot make definite estimates until underground work has been undertaken. The company also has a property in South Lorrain, where some encouraging results have been obtained. A small shipment of high-grade ore has already been made, and it is expected that production will at least pay operation costs. The company has $1,684,270 on hand, and investments to the value of $2,405,433.

The annual report of the Mining Corporation for 1926 shows production of 2,210,053 oz., an increase of 10 per cent over the record for the preceeding year. From this ore was realized a profit of $622,509, and after including various deductions, a balance of $511,186 remained, compared with $602,167 in the provious year. Dividends to the amount of $415,012 were paid. The company has $313,000 on hand, and government and municipal bonds to the value of $600,500.

It is understood that the option on N. A. Timmins' controlling position with regard to the Alderson-McKay and Waite-Montgomery properties in Rouyn has expired. There still appears, however, to be substantial grounds for the belief that these properties will eventually be taken over by the Noranda and paid for by an issue of shares. In the meantime, however, preparations are being made to carry on the Alderson-McKay as a separate unit. Several drills will be put to work at once.

The St. Louis Refining & Smelting Co. is understood to have optioned 1,800 acres of ground in the vicinity of the Bunker Hill & Sullivan options in the Sudbury district. Some of this ground is under water. Diamond drilling has been started in several areas.

News From Washington

By PAUL WOOTON
Special Correspondent

First Potash Drill Core from New Mexico Commercially Disappointing

THE core from the first potash well drilled by the U. S. Bureau of Mines in New Mexico is commercially disappointing. Though interesting showings of potash were encountered it is apparent that no important stratum of potash exists at the point where this sample was taken.

New contracts which have now been approved by the various legal officials concerned will open the way for drilling the sites which the Geological Survey selected in Texas. These were the preferred sites, but a change had to be made in the law before the land owners would enter into the agreement to reimburse the government from any sales of potash that might result from discoveries. The remaining two sites in New Mexico will be drilled, however, before any drilling will be done in Texas.

Bound volumes of the Bureau of Mines mineral resources chapters are to be made available much more promptly in the future. Arrangements have been made also for the early publication of the 1923, 1924, and 1925 volumes. Later in the year the 1926 volume will be made available. Although the separate chapters making up the mineral resources volume have been issued fairly promptly, there has been complaint, from those who use the figures frequently, that the bound volumes have been delayed. F. J. Katz, who is in immediate charge of these statistics, is now in the West arranging to get earlier returns, so that the mineral resources volume, with complete figures, will be ready for distribution before the end of the year following that covered by the figures.

The committee of the Iron and Steel Institute having charge of blast-furnace research work has invited the specialists on the subject on the staff of the Bureau of Mines to co-operate in the discussion of the problems involved. Representatives of the Bureau also will co-operate with those interested in open-hearth research.

Four of the bureaus of the Department of Commerce will participate in the Chautauqua of Swarthmore College. Representatives of these bureaus will fill a series of speaking engagements throughout the country, telling of the public service each bureau is performing. The speaker for the Bureau of Mines will detail what is being done in the interest of those who produce and consume mineral commodities and of those who work in mines.

Dr. I. C. Smith, who is studying silicosis in Canada for the Union of South Africa, will exchange information on the subject with the Bureau of Mines. He expects to visit Washington in the near future.

Anaconda to Build Electrolytic Zinc Plant at Anaconda

James R. Hobbins, vice-president of the Anaconda Copper Mining Co., recently stated that as soon as plans and specifications now being prepared are finished the company will begin the erection of an electrolytic zinc plant of 150 tons' metallic zinc per day capacity, on Smelter Hill at Anaconda, Mont. The plant will increase the electrolytic zinc refining capacity of the company in Montana approximately 50 per cent.

At present, the electrolytic zinc refinery at Great Falls has a rated capacity of 300 tons of cathode zinc per day and is producing approximately 20,000,000 lb. of ingot zinc per month. The new Anaconda plant will be about one-half the capacity of the Great Falls plant and will produce approximately 10,000,000 lb. of ingot zinc per months. Ores and concentrates to supply these plants will be drawn from the Butte zinc mines and from smaller Montana zinc-mining operations outside of the Butte district. A large part of the zinc tonnage to be treated will also come from the Salt Lake mining district, in Utah, and from the Coeur d'Alene mining district, in northern Idaho.

The new plant will cover about six acres and will require approximately 30,000 hp.

New Gold Rush Reported North of Yuma, Ariz.

Another gold strike in Arizona is reported from the Kofa district, about 75 miles northeast of Yuma, in the vicinity of the Colorado River. The find was made by an old prospector named James McDonald, who arrived in Yuma with rich samples which he claimed had been taken at random from his six claims in that district. Experienced men who are said to have examined the samples reported that they would run $50,000 to the ton. Immediately an exodus took place, and every old-timer in the town who had a grubstake, or was able to obtain one, left for the new field. Many Yuma merchants and professional men contemplated dropping their business and driving to the mountains in search of claims.

The McDonald claims are said to be about 75 miles northeast of Yuma and about half a mile east of the old King of Arizona mine, which is in the heart of the Kofa district and at one time produced many hundreds of thousands of dollars' worth of gold ore. The North Star, in the same district, also a heavy producer, is said to have been sold by its discoverer, Felix Mayhew, of Yuma, for $500,000. The New King of Arizona mine is operating in the district.

Operations in Wickenburg, Ariz., District Active

High-Grade Ore Opened by South Belmont Company—Vulture Mine Sold to Connecticut Interests

A 17-ft. vein of gold-, silver-, and lead-bearing ore is reliably reported to have been opened by the South Belmont Mining Co. in the company's main crosscut at a depth of approximately 225 ft. The strike occurred at a point approximately 7,500 ft. west of the Tonopah Belmont workings, in the Wickenburg district of Arizona, and appears to be along the same line of contact.

Properties lying between the South Belmont and the Tonopah Belmont line are the claims owned by Ed Lemon, H. C. Reedall, and the Jim Butler Mining Co. Work on the Jim Butler claim was started this week, and Reedall is building a camp preparatory to beginning work on his property.

The South Belmont discovery occurs in an andesite breccia, near the contact of the andesite with a stream of rhyolite, and the highest percentage of lead is carried in that part of the vein nearest the rhyolite. Because of the increase of lead in the footwall andesite, it is expected that the vein at the 200 will also show a substantial increase in values.

Southeast of the Divide Extension, and on the same contact zone as Divide Extension and Belmont, J. R. Davis, of Wickenburg, is prospecting a big body of surface vein material, carrying fair values in gold, copper, lead, and silver. It is reported that this property has been transferred by Mr. Davis to the Arizona Associated Mines Co.

The Tonopah Belmont Development Co. has completed a 5-mile pipe line to the new water well and also has sunk a shaft to the 600 level. An ample supply of water for all purposes seems assured, and it is predicted that operations will be resumed about May 1.

In the Camp Belmont district work is steadily progressing at the Moon Anchor, Moon Anchor No. 1, and Chance group of claims. The Moon Anchor shaft is being deepened from the 130 to the 300 level, and Moon Anchor No. 1 shaft is nearing the 100 ft. point, and on the Chance property surface trenching and stripping of the veins are in progress. The Chance vein has now been opened by trenches and shallow shafts for a total length of 3,000 ft., of which distance about 1,300 ft. is on Moon Anchor No. 1 ground and 1,700 ft. on the Chance property. The vein varies in width from 4 to 18 ft. and contains principally lead and gold ore, which occurs as a replacement of the andesite breccia vein filling.

Some fifty years ago the Vulture mine was discovered by Henry Wickenburg, who gave his name to the little town on the Santa Fe Railroad about 50 miles north of Phoenix. During the period since its discovery the mine is said to have yielded about $25,000,000. Recently the tailings dumps were reworked by a group of San Francisco men, who obtained satisfactory results.

During its life several different companies have worked the Vulture, which was closed down at intervals, owing to the faulting of the vein, which was ultimately re-discovered by the succeeding company. The mine was re-worked until about 1912, when the vein was again lost.

The new owners plan to start prospecting soon for the faulted segment, and crosscutting to the north and south, in search of parallel veins.

Formal announcement of the property transfer to Waterbury, Conn., interests, brought out the information that the new owners have had mining engineers in the district for months, among them a Mr. Finlayson, who has been making surveys and taking samples. A group of eleven claims adjoining the Vulture and formerly owned by A. P. Irvine will be assigned to the Vulture Extension Mining Co., according to reports. The sale of the old Vulture property is the fourth sale of old and widely known mining properties within a radius of 30 miles of Wickenburg made within the last fourteen months. First the old McNeil mine, at Camp Belmont, was bought by the Tonopah Belmont Development Co., of Nevada. This property is developing into a gold-lead producer. The second was the old Congress mine, 17 miles north of Wickenburg, which is now owned by the Sonora Development Co., and is making regular shipments of high-grade gold concentrates to the smelters, and which at the present time is said to be increasing its milling plant to 250 tons' capacity daily. Third was the old Monte Cristo mine, purchased by the Julian Merger Mines, Inc., and which is preparing to ship high-grade silver ore.

A depth of 640 ft. has been reached in the sinking of the three-compartment shaft of the Phelps Dodge Corporation mine in Warren, according to officials in charge of the work. The work was started Jan. 15, under direction of the E. J. Longyear Development Co., shaft-sinking contractors. Approximately 7 ft. per day has been averaged in the sinking operations. A station will be cut when a depth of 700 ft. has been reached.

Decision Rendered Against Hudson's Bay Company

The Supreme Court of Canada has decided that gold and silver on the lands of the Hudson's Bay Company in northern Canada belong to the Dominion. This ends a long-drawn-out dispute in the courts. The Supreme Court finds that King Charles II in 1670 granted a charter to Prince Rupert and his company of gentlemen adventurers, which gave them a vast territory around Hudson Bay. They were "absolute lords and proprietors"; in express terms they were given "all mines of gold, silver, gems and precious stones to be found and discovered within the territory and limits."

Soon after Canada became a dominion the Hudson's Bay Company surrendered its northern empire, receiving western settlement lands in exchange. The point in the case which has now been decided was whether in making the surrender the company had also surrendered ownership of precious metals in the lands occupied by the company.

Mexico City Letter

By W. L. Vail
Special Correspondent

Mining Production Practically Constant During Last Eight Months

Mexico City, April 25—The first four months of this year find the Mexcian mining situation, so far as production is concerned, practically the same as during the last four months of 1926. There has been a slight decrease in operations in the smaller camps, but most of the larger mines have increased their production.

The so-called revolutionary activities have embarrassed some districts—Oaxaca and Jalisco particularly—because of the confiscation of extra rolling stock for military purposes, but otherwise the working of mines can hardly be said to have been affected by the restless movements of citizens, except in isolated cases. There has been a closing down of a number of smaller properties because of the exactions of the new mining laws and petty official restrictions, but at the present time strong representations from all over the republic are before the president for a modification of the most recent mining code.

The general tendency of the larger organizations is to continue along the lines of readjustment begun when silver declined and the new mining laws were made effective. This means forced economy in many instances, reduction in man-power, and particularly a reduction in exploration work.

The recent strike of a vein of high-grade gold ore by the Mexican mines, at El Oro, State of Mexico, is considered to be unimportant. Camps at El Oro and Tlapahuala are apparently doomed. Esperanza is worked out, with the exception of occasional rich stringers or small veins. El Oro Mining & Railway Co. is in the same condition, so far as this district is concerned, though the company continues to operate with profit the Santa Maria and La Noria, in the State of Zacatecas, and the Buena Tierra, a rich lead property in the State of Chihuahua.

Dos Estrellas, at Tlapahuala, continues to limp along on wastes and fillings of the rich old workings. The company has recently taken up a number of smaller adjacent properties—among them La Lucha—with good ore values. The present ores at Dos Estrellas are averaging about 80 gm. silver and 2 gm. gold. Actual cost of extraction is 64c. The Dos Estrellas has been for many years one of the largest gold producers of the republic; in 1925 it produced one-eighth of the entire gold output of the country. The company was originally organized more than thirty years ago with native capital. It was later taken over by French interests. The towns at El Oro and Tlapahuala are being rapidly deserted.

The Cocheno Mining Co., Chihuahua, denies the published reports that the plant has been shut down. On the contrary, the company is actively engaged in completing a new flotation plant.

London Letter

By W. A. Doman
Special Correspondent

Union Corporation's First Report on Development at East Geduld Mines Encouraging

London, April 19—When the Union Corporation secured the last lease area on the Rand, and, conjointly with the Geduld Proprietary, floated it as the East Geduld Mines, it was known that results would not be long deferred. Half a dozen workings of the Geduld Proprietary were already on the boundary; it was simply a matter of extension, and no preliminary shaft sinking was necessary. The first development report has just been issued; it covers the March quarter, and shows that the total footage accomplished was 1,769, of which 1,600 was sampled, the payable reef disclosures being 800 ft., having an average assay value of 11.3 dwt. over 45 in. This is distinctly encouraging, for it would indicate tonnage above the average value of the parent company's reserves.

At a meeting of the shareholders of the Lena Goldfields last week it was stated that under present arrangements 75 per cent of the gold is sold to the Soviet Government and the remaining 25 per cent comes to London monthly, but under the concession the company is entitled to bring the whole of the gold to London in the event of not being able to agree to terms for gold in Russia. The dividend question, which is always uppermost in shareholders' minds, was also mentioned. The chairman stated that the company is "permitted to bring all money received on account of earnings or otherwise to this country, and it was known that the results of the past year had been quite satisfactory. The gold received at present amply covered the note interest and other expenses in London." The meaning of this clearly is that dividends cannot be paid as yet.

There were some exciting moments on the Stock Exchange toward the end of last week, when Mount Isa (Queensland) shares were heavily offered and fell to 30s. after being £2. Various explanations were put forward, and it is not easy to say which was the determining factor. It is generally believed the position is as follows: The Anglo-American Corporation had 50,000 shares firm, and sold them at a good profit. It also had an option over 500,000 additional shares, to be exercised if the reports of its engineers were satisfactory. Option dealers, seeing the price decline, and knowing that the Anglo-American had disposed of its firm stock, sold the shares which they had bought to cover dealings for clients, so that the latter lost not only their option money but the chance of calling shares. The Anglo-American Corporation had obtained an extension of its option. Now the public is beginning to learn that option dealings are best left to professionals.

At the annual meeting of shareholders in the Rio Tinto company the chairman remarked that the board joined the Copper Exporters, Inc., of America, as a foreign associate, but only after securing certain terms to which the directors felt their position in the European market entitled them. In conjunction with the Metallgesellschaft of Frankfurt, the directors have formed the European Pyrites Corporation to organize the sale of ore and residues over the greater part of the Continent. Although the Rio Tinto will cease to be a member of the Pyrites Producers' Association after 1928, it has entered into an agreement with the Tharsis company for a period of years, commencing with 1929, for co-operation in the selling of ores. The Rio Tinto has also acquired the whole of the output outside Scandinavia of the Orkla mine. This gives a considerable copper-ore tonnage which is also an arsenic-free sulphur ore.

Another Tax Proposal Affects the Joplin-Miami District

Mine operators of the Oklahoma section of the Joplin-Miami district are being urged to oppose a proposed new severance tax for all minerals. An initiative petition is being circulated throughout the state, calling for the enactment of the measure as a constitutional amendment without the help of the legislature. The proposal is to place a severance tax of 2 per cent on all oil and gas production and of 1 per cent on the zinc and lead produced in the state. This tax would be in addition to the gross production and other taxes now being assessed, regardless of whether producers of these minerals make a profit. Half of the revenue derived from the severance tax would be allotted to the school fund and the other half would go to the road fund of the state.

At a recent meeting of the Tri-State Zinc and Lead Ore Producers' Association at Picher, Okla., it was estimated by J. D. Conover, secretary of the organization, that the severance tax, should it be enacted, would cost the ore producers approximately $350,000 a year. A committee composed of F. N. Bendelari, president, of the Consolidated Zinc & Lead Co.; John Robinson, of the Commerce Mining & Royalty Co.; and M. F. Owens, manager of the Black Eagle Mining Co., was appointed.

New Mining Companies Formed in Montana Districts

The Ohio Placer Mining Co. has been incorporated with a capital of $50,000. It plans to conduct placer mining operations at Quartz, Mineral County, Mont.

The latest operations in the southwest portion of Butte are those conducted by the Butte Independent Mines Co. The company is working the Anna, Examiner, and seven other claims situated west of Williamsburg. A shaft is being sunk on one of the major veins traversing the property.

To aid in the financing and development of meritorious mineral properties in the West, the Western Mines Finance Co. has been formed and has opened an office at Butte. The company expects to open Spokane and Boston offices.

Johannesburg Letter

By John Watson
Special Correspondent

Virgin Gold Field Reported in Northern Natal—Tin Claims Staked at Jamestown

Johannesburg, March 29—The output of gold from Southern Rhodesia for 1926 amounted to 593,428.99 oz., valued at £2,508,527. These figures, compared with 1925, show an increase of 11,924.67 oz., but a decrease in value of £31,015, owing to the gold premium existing during the first four months of 1925. The output of other minerals from Rhodesia in 1926 follows:

	Quantity	Value
Silver, oz.	110,023.98	£13,844
Copper, tons.	7.70	100
Chrome ore, tons.	181,194.17	420,334
Coal (raised), tons.	963,579.00	399,229
Asbestos, tons.	33,344.09	726,835
Arsenic, tons.	53.50	972
Tin, tons.	15.69	4,639
Mica, tons.	183.11	22,930
Barytes, tons.	30.00	41
Corundum, tons.	43.34	213
Iron, tons.	2,119.80	1,396
Antimony, tons.	33.00	749
Lead, tons.	6.24	172
Tantalum, tons.	1.00	60
Diamonds, carats.	105.50	551
Total		£1,592,065

In a paper read before the Chemical and Metallurgical Society, in Johannesburg, on March 19, I. Davidson described the final clean-up of an old reduction plant at Langlaagte Estate, when 1,900 oz. of gold was obtained from scale on old iron tanks and 1,450 oz. from steel extractor boxes.

Correspondents at Barberton report activities among prospectors in that district and on the Swaziland border, near Oshoek. At Jamestown, several hundred claims were pegged, for what is thought to be a discovery of alluvial tin. Along the southern slopes of the Devil's Kantoor extensive pegging took place for asbestos. Practically the whole of the farm Oshoek—the last property on the main road to Swaziland—has recently been pegged in base-metal claims. An engineer representing London interests has been examining the cassiterite gravels; others have been on the large flat along the Motshana River.

The Star on March 23 drew special attention to the coal and other mineral resources of Vryheid, in northern Natal. Within 60 miles of that town there is said to be a large virgin gold field, assaying between 5 and 6 dwt. to the ton. One of the reefs, 30 in. thick, is stated to be practically free-milling ore. The only gold mine being worked in that district is the Wonderfontein mine, in the Ngotshe division. In addition to gold, there are deposits of graphite, asbestos, slate, copper, manganese, and kaolin.

On the Johannesburg Stock Exchange during the past week business on the share market was fairly quiet. Consolidated Main Reefs have been the leading feature and have risen 4s. from 19s. 4½d. New Modders have improved by 3s. to 119s. Modder East rose from 23s. to 26s. 9d. Crown Diamonds have risen from 6s. to 7s. Anglo-American Corporation improved to 43s.

People You Should Know About

Arthur W. Allen returned to New York from London on May 2.

Forest Rutherford, consulting metallurgist, 50 Broad St., New York City, is in Utah on professional business.

George Kingdon, general manager of the United Verde Extension Mining Co., has returned to Jerome from a trip to Chile.

A. J. Brett, consulting engineer to the Central Mining and Investment Corporation, in London, has returned from Johannesburg to England.

James Gilluly, of the Geologic Branch of the U. S. Geological Survey, is engaged in field work in the Stockton and Fairfield quadrangles, in Utah.

James MacNaughton, president of Calumet & Hecla Consolidated, has returned to Calumet, Mich., after a business trip to Boston, Mass., and a pleasure trip to the Bahamas.

L. D. Knight, manager of the Ingersoll-Rand Company; **D. C. Keefe,** sales manager, and **Frank Carroll,** Western representative of Ingersoll-Rand visited Butte recently.

W. J. Hosking, engineer of the Tough-Oakes gold mine, at Kirkland Lake, Ontario, has resigned to accept a position with a mining company in the Rouyn district of northwestern Quebec.

W. R. Bauder, of Chicago, mining engineer, is making a survey of the mineral possibilities along the proposed right-of-way of the Wyoming North & South Railroad between Casper and Rawlins.

D. A. L. Hall, assistant director of the Geological Survey of the Union of South Africa, has returned from Capetown to Pretoria, after an official visit in connection with the proposed iron and steel industry.

Duncan Smith, mining engineer and metallurgist, has left Central Africa for Bruxelles and will be in New York the latter part of May. Letters should be addressed in care of the Guaranty Trust Co., 140 Broadway, New York City.

L. C. Shattuck, president, and five other officers and nine directors of the Shattuck Denn Mining Co., were re-elected at the annual stockholders' meeting of the company, held in Bisbee, Ariz., on April 21.

H. W. Clark, mining engineer for the New Guinea Gold & Osmiridium Co., after returning to Australia from New Guinea, left for London on business connected with the proposed sale of that company's interests to a London mining group.

John L. Rich, petroleum geologist of Ottawa, Kan., on April 21 delivered an address before the Toronto branch of the Canadian Mining and Metallurgical Institute, on the Ranney oil-mining process, with a view to its adoption in the oil fields of Ontario.

Herbert Carmichael has returned to Victoria, B. C., from a four months' visit to London, where he went to finance the erection of an ore-treatment plant on the site of the old Tyee smelter, at Ladysmith, B. C. It is understood that the erection of the plant is to start at once.

W. G. McBride, manager of the Old Dominion company at Globe, Ariz., who, as recently announced, will become head of the School of Mines of McGill University, will be succeeded by **I. H. Barkdoll,** at present mine superintendent. **Harry Leidig,** now connected with the Morenci Branch of the Phelps Dodge Corporation, will succeed Mr. Barkdoll as superintendent.

George Otis Smith

George Otis Smith, director of the U. S. Geological Survey, on April 30 rounded out his twentieth year as the fourth director of the Survey (after Clarence King, 1879-1881; Major Powell, 1881-1894; and Doctor Walcott, 1894-1907). Doctor Smith was congratulated by the members of the Survey Staff who were in Washington in the afternoon of May 2.

Thomas Varley, who has been superintendent of the Intermountain Experiment Station of the U. S. Bureau of Mines for many years, has resigned to open an office and ore-testing laboratory in Salt Lake City. He will specialize in the concentration of ore by gravity methods as well as by flotation. Most of the Bureau's work on flotation has been done under the supervision of Mr. Varley.

Alex Laist, superintendent of the Quincy copper smelter at Hancock, Mich., for the last twenty years, has resigned to become associated with his brother, **Frederick Laist,** metallurgical manager for the Anaconda Copper Mining Co. Mr. Laist will assist in the construction of a new $1,000,000 metallurgical establishment, an electrolytic-zinc plant which will be built by the Anaconda company at Anaconda.

M. T. Elser, a one-time resident of Queensland, Australia, but who has for many years been a resident of California, has lately gone to Queensland to interview the Minister for Mines there with a view to extending the marketing of Queensland gems to the United States, where he considers they should find a ready sale. At present a firm in Europe has the agency for the sale of Queensland sapphires under a government pool, but purchases from the miners under this pool have been stopped for about twelve months past, pending the disposal of unsold gems that have accumulated with the agents.

Dorsey A. Lyon, chief metallurgist of the U. S. Bureau of Mines, and **F. J. Katz,** chief engineer of the division of mineral resources and statistics, visited Salt Lake City recently to hold a series of conferences relative to forms and general procedure. Others attending the conference were **C. M. Henderson,** engineer in charge of the division of mineral resources and statistics at Denver; **J. M. Hall,** engineer in charge at San Francisco; **Victor Heikes,** engineer in charge of Salt Lake, and **C. N. Gerry,** statistician.

G. H. Dowell, manager of the Copper Queen branch of the Phelps Dodge Corporation, has tendered his resignation as manager of the Copper Queen, owing to ill health. **Captain J. P. Hodgson,** manager of the Morenci branch of Phelps Dodge, will take the place made vacant by Mr. Dowell's resignation. **Frank Ayer,** at present manager of the Moctezuma Copper Co., at Nacozari, Sonora, Mexico, a subsidiary of Phelps Dodge Corporation, will take the managership of the Morenci branch, when Captain Hodgson goes to Bisbee. **H. H. Horton,** who has been connected with the Moctezuma Copper Co. for many years, will assume charge of operations as assistant manager, and **E. E. Leland** will be general superintendent.

Obituary

John C. Oliver, a director of the Calumet & Arizona Mining Co., died April 28, in Baltimore, Md. Mr. Oliver was a director of C. & A. since 1920 and was an associate of Thomas F. Cole, well known in the mining industry. He was a member of the family which controlled the Oliver Iron Mining Co. on the Gogebic and Mesaba iron ranges.

John R. Stanton, for many years associated with his late father, John Stanton, nestor of the copper mining industry in America, in the executive affairs of the Stanton group of mines in the Lake Superior copper district of Michigan, died at Galesville, Wis., April 28. The Stantons took a prominent part in the expansion of the copper-mining industry in the Michigan district, particularly in the years between 1898 and 1905.

Judge Dan C. McDonald, original locator of the Ruth claims, now belonging to the Nevada Consolidated Copper Co., died at his home at Ely, Nev., on April 24. Judge McDonald, who was one of the oldest pioneer miners of the Sagebrush State, promoted development of the old Ely-McDonald mine, at Keystone; the Ruth mine of the Nevada Consolidated, and also operated at Pioche, Eureka, Bristol, Ward, and other camps. He was a native of Nova Scotia and was born in 1859. He came to Elko, Nev., when only fifteen years of age. The Ruth mine, at Ely, he named after his daughter, Mrs. Ruth Marcotte.

Societies, Addresses, and Reports

Flotation of Oxidized Lead-Silver Ores

Albert W. Hahn Discusses Subject in Paper Presented at April Meeting of the Utah Section of the A.I.M.E.

A PAPER on the progress made in the flotation of oxidized lead-silver ores was presented at the April meeting of the Utah section of the American Institute of Mining and Metallurgical Engineers by Albert W. Hahn, vice-president and general manager of the Eureka Metallurgical Co., of Salt Lake City. Excerpts from Mr. Hahn's paper follow:

Flotation treatment of oxidized ores on a commercial scale was begun in 1918 by the Shattuck Arizona Copper Co. Tabling followed by flotation concentration was employed. At present, the Shattuck Denn Mining Corporation, successors to the Shattuck Arizona, is employing straight flotation and treating about 200 tons daily. In 1922 the San Diego mill of the American Smelting & Refining Co., in the Parral district, Chihuahua, Mexico, started operating a 600-ton mill on a mixed sulphide-oxide gold-silver-lead ore. Tables and flotation are used, and about 200 tons of oxidized slime are treated by flotation. In 1923 the Eureka-Holly Mining Co. put a 90-ton mill into operation at Eureka, Nev., using tables and flotation on an oxidized lead-silver ore. In 1924 the American Smelting & Refining Co. started a 250-ton mill in northern Peru to treat a high-grade oxidized gold-silver ore with low lead value content. In 1924 the Grand Central Mining Co. began treating old oxidized gold-silver-lead tailing over a 200-ton flotation mill at Fairbank, Ariz. In 1926 the Compania Internacional Minera, a subsidiary of the Union Corporation of London, started a 250-ton flotation mill on oxidized lead-silver ores. During April of this year the Phelps Dodge Corporation will probably put a 250-ton mill into operation at Warren, Ariz., on oxidized lead-silver ores similar to those being treated in the Shattuck Denn mill.

All of these mills use sodium sulphide for filming the oxide minerals, with the possible exception of the North Peru mill, and all use oily reagents. The total tonnage of strictly oxidized lead-silver ores concentrated by flotation is probably less than 2,500 tons daily. The various types of ores being treated are mentioned in Table I.

Where mixed sulphide and oxidized minerals are present, the sulphides are recovered either by table concentration, as at the San Diego mill, and the table slime tails sulphidized with sodium sulphide and floated, or by primary flotation, as at the Shattuck Denn mill, and the primary flotation tailing sulphidized and floated. In the Northern Peru operation, a single flotation operation gives good results.

At the Grand Central mill, straight flotation is employed, but the temperature of the pulp during sulphide filming is maintained above 130 deg. F. The quantities of sodium sulphide vary from 2 to 6 lb. per ton. Sodium silicate is also added at the Shattuck Denn mill. Small amounts of xanthate, P. & E. oil, Barrett No. 4, Lewis tar, Eureka Metallurgical Co. No. 70, Yarmor pine, and wood creosote are also used at the various plants. Mechanical agitation flotation machines are used at each of these mills.

Each sample is an individual problem. Our experience shows the relative floatability of the lead minerals to be:

1. Cerussite, lead carbonate.
2. Anglesite, lead sulphate.
3. Wulfenite, lead molybdate.
4. Pyromorphite, lead phosphate.
5. Mimetite, lead arsenate.

If these minerals can be filmed with a soluble sulphide, they can be floated. The time required for filming varies with the type of lead mineral, in about the above order. When the phosphate and arsenate minerals are present, the addition of caustic soda aids in sulphidizing.

The principal difficulties encountered when attempting to float oxidized ores of any type are the presence of:

1. Soluble salts.
2. Colloidal slime.
3. Large amounts of oxides of iron and manganese.

Soluble salts of the heavy metals, such as iron and manganese sulphates, consume large quantities of sodium sulphide, and all soluble salts except those of the alkaline group tend to flocculate the pulp, which is extremely detrimental to successful oxidized ore flotation. Dispersing or peptonizing agents, such as sodium silicate, will eliminate this difficulty provided the amounts of soluble salts present are not excessive.

Colloidal slime has a profound effect on recoveries. By colloidal slime is meant that portion of a 2 to 1 pulp remaining in suspension on standing three minutes, after the ore has been ground with sodium sulphide, sodium silicate, and other reagents, and poured into a pan four inches high. This slime consumes sodium sulphide and other reagents, probably by adsorption and—what is more detrimental—occludes values which, as far as we know, are not recoverable by any other method than leaching. Some idea of how this slime affects recoveries can be gained from the tests shown in Table II.

All our efforts to recover the values in the slime tailing by any method other than leaching have been failures, and leaching methods are too costly. Our tests have shown conclusively that when slime is present the pulp must be in a "dispersed" condition to float successfully the values, and that sodium silicate is the best addition agent for this purpose. Slime also lowers the grade of the concentrates produced.

Oxidized iron and manganese minerals, especially when in the form of slime, consume excessive quantities of sodium sulphide, and can exist in an ore to such an extent as to consume 20 or 30 lb. of sulphide per ton of ore,

Table I

Mill	Heads Au, Oz.	Heads Ag, Oz.	Heads Pb, Per Cent	Concentrate Au, Oz.	Concentrate Ag, Oz.	Concentrate Pb, Per Cent	Tailing Au, Oz.	Tailing Ag Oz.	Tailing Pb, Per Cent
Shattuck Denn	0.10	6.8	6.1	0.82	40.2	39.0	0.02	1.6	0.55
Eureka-Holly	0.01	2.5	10.0	0.15	25.0	55.0	Tr.	1.2	2.2
San Diego	0.03	4.5	4.0	....	....	....	0.01	2.5	2.0
A.S. & R. Co., Peru	0.40	55.0	1.0	....	....	....	0.03	3.0	Tr.
Grand Central	0.09	4.5	5.8	0.25	14.0	33.0	0.03	3.3	2.8

Table II

	Per Cent Weight	Silver Oz.	Silver Per Cent	Lead, Per Cent	
Heads	100.0	39.9	100.0	1.20	100.0
Sand tailing	54.8	2.95	4.1	0.10	4.6
Slime tailing	10.0	25.3	6.3	1.10	9.2
Heads	100.0	....	....	15.5	100.0
Sand tailing	17.0	....	....	0.90	3.1
Slime tailing	20.2	....	....	6.48	5.5
Heads	100.0	14.3	100.0	2.60	100.0
Sand tailing	37.6	3.0	7.9	0.6	8.7
Slime tailing	3.8	11.4	3.0	2.9	4.0

Table III

	Assay Au, Oz.	Assay Ag, Oz.	Assay Pb, Per Cent	Assay Fe, Per Cent	Assay CaO, Per Cent	Assay Insol., Per Cent	Per Cent Contained Au	Per Cent Contained Ag	Per Cent Contained Pb
Heads	0.05	2.6	6.5	....	....	....	100.0	100.0	100.0
Table concentrate	0.32	18.0	39.7	10.2	....	3.1	62.3	61.9	54.0
Flotation concentrate	0.25	14.0	32.3	5.8	14.2	5.8	37.7	38.1	35.5
Combined concentrate	0.29	16.2	36.3	8.2	8.0	3.6	100.0	100.0	89.5
Tailing	Tr.	Tr.	0.8	....	....	....	.....	.....	10.5

Ratio of concentration, 6 tons into 1 ton of combined concentrate.

Table IV

	Assay Au, Oz.	Assay Ag, Oz.	Assay Pb, Per Cent	Assay Fe, Per Cent	Assay Insol., Per Cent	Per Cent Contained Au	Per Cent Contained Ag	Per Cent Contained Pb
Head	0.03	11.4	6.5	....	....	100.0	100.0	100.0
Flotation concentrate	0.10	91.5	53.1	5.0	14.6	67.4	78.6	87.7
Tailing	0.01	2.7	0.9	....	....	32.6	21.4	12.3

which, it is obvious, are prohibitive amounts.

The ideal oxidized lead-silver ore for a flotation operation, provided economic factors, such as water supply, power, and accessibility, are normal, is one having the following composition: Silver, 5 oz. and up; lead, 5 per cent and up, in the form of carbonate, combined iron and manganese not over 12 per cent, lime not over 10 per cent, and insoluble, above 50 per cent. This type of ore usually contains only a small amount of colloidal slime; it is easily sulphidized and floats about as readily as a galena ore. The reason for placing a limit on the lime is that we have found that some types of lime carbonates, especially aragonite, float quite readily, which lowers the grade of the concentrate. A combination of table concentration and flotation on this type of ore will usually cut down the amount of sodium sulphide required and often increase extraction to some extent.

An example of combined tabling and flotation on an ore from California is shown in Table III, on page 781.

The laboratory reagents used on the table tailing shown in Table III were 5 lb. sodium sulphide, 6 lb. sodium silicate, 3 lb. P. & E. oil, and 1 lb. of reconstructed Yarmor pipe oil per ton of table tailing. Without table concentration, but a straight flotation operation, recoveries were the same on the gold and silver, but 5 per cent lower on the lead. Consumption of sodium sulphide was double in amount. This test is also an example of the floatability of calcium carbonate, namely, 14.2 per cent CaO in the flotation concentrate.

An example is shown in Table IV of straight flotation on a siliceous oxidized silver-lead ore. I have selected a 90-ton test-mill run on ore from the Victoria mine of the Bingham Mines Co. The gold and silver in the ores from the Tintic district appear to be occluded to some extent in the gangue material, so that the tailing is relatively high in these two metals. This characteristic is particularly true of some ores from the Chief Consolidated orebodies.

Finer grinding does not improve the recoveries of gold and silver. The lead mineral is quite distinct from the occluded silver, as shown by the fact that only six minutes in the flotation machine is necessary to recover the lead in a rougher concentrate running 57 per cent, the silver lagging behind.

A summary of the governing factors determined, up to the present, regarding successful oxidized lead ore flotation, which also applies to some extent to oxidized copper ores, follows:

1. If the valuable oxidized minerals can be sulphidized and these sulphidized minerals, when treated with flotation reagents and agitated with air, gather into flocculated aggregates of the valuable minerals and air, and the gangue material remains in a dispersed condition, then a commercial recovery of the valuable minerals can be obtained.

2. The pulp must be, and remain in, a dispersed condition during the flotation period.

3. The amount of so-called colloidal slime in the pulp should not exceed 15 per cent.

4. The amounts of oxidized iron and manganese in the ore should not exceed 15 per cent.

5. If the ore contains both sulphide and oxidized minerals, the sulphides should be removed by either tabling or primary flotation before attempting to sulphidize and float the oxidized minerals.

Otto Ruhl Reviews Progress in Tri-State District

A paper presented at the annual meeting of the American Zinc Institute held at St. Louis on April 18, by Otto Ruhl, consulting mining engineer of Joplin, Mo., reviews the progress made during 1926 in the Tri-State zinc-lead district. Excerpts are published below.

Continuing its record breaking, the Tri-State district in 1926 surpassed the 1925 record of zinc production in spite of a decreased price for its product. The zinc-ore tonnages shipped for the two years compare as follows:

Year	Tons of Zinc Concentrates	Average Price per Ton	Gross Value
1926	840,756	$48.94	$41,149,434
1925	814,317	53.43	43,510,847

The increase in tonnage of shipments was 26,439. Reserve stocks at the end of 1925 were estimated at 8,000 tons, and at the end of 1926 at 9,000 tons. On the other hand, the average market price dropped $4.50 per ton, and, in spite of the increased output, the gross value dropped off $2,361,413.

There were no great outstanding factors in the year's activities. Prospecting continued steadily in all parts of the district, but showed considerable abatement near the close of the year. Considerable progress was made in the Missouri camps of Spring City, Granby, Duenweg, Joplin, and Waco. In Kansas there was some development at Waco and Crestline, but the major part of the development in that state was centered in the areas west and south of Baxter Springs.

In Oklahoma there have been very few developments. The northwest extension of the field seems to have reached a standstill, but to the west the Anna Beaver Mines Co. has shown a very creditable development, and has built the largest mill of the year. The remaining Oklahoma development has been in the nature of drilling more intensively in and around the older mines, and considerable extensions have taken place. As pointed out last year, the percentage of recovery in the Oklahoma district shows a decline from the record of previous years; but this is not so apparent as it might be, due to the fact that many mills have added flotation plants, which not only have been recovering ore previously lost, but have, in addition, handled slime from old pond accumulations. These operations have added concentrates to the bins that really did not come from present-day mining, and thus, to a certain extent, the recovery appears higher than it really is.

Perhaps the outstanding feature of the year has been the trend toward rehandling tailing. It is estimated that approximately thirty tailing mills are now operating. These plants are adding a very considerable tonnage of concentrates, and their number will be materially increased in 1927. The mine operators' association reports approximately 1,200 tons per week from this source. Another feature of growing importance is the percentage of flotation concentrates to the jig and table concentrates. Approximately 125 flotation units have been installed in the district. With the production of 17,000 tons of zinc concentrates per week, it is apparent that the district is keeping up its production capacity in spite of predictions to the contrary. But it is also significant that of this production about 1,200 tons is coming from tailing mills, and 2,500 to 3,000 tons from flotation plants. This latter output is either from old tailing piles and pond accumulations, or is ore that has hitherto been partly lost.

This year also saw the first organization of the mining engineers of the field. For the last five years there has been a steady growth, both in the activities of the engineers, as well as in numbers. The growth of the larger companies has made it necessary for them to establish their own engineering corps, so that today there are in the district from 150 to 200 men doing some character of engineering service. The new organization is a regularly organized section of the American Institute of Mining and Metallurgical Engineers; it has enrolled 135 regular and associate members.

Tri-State A.I.M.E. Meeting

New employees are most susceptible to accidents in mining, according to figures compiled by R. V. Ageton, safety engineer of the Tri-State Zinc and Lead Ore Producers' Association, and explained by him in an address at a meeting of the Joplin-Miami section of the American Institute of Mining and Metallurgical Engineers, held in Joplin on April 27. The following papers were presented at the meeting:

"A History of Accident Prevention and Welfare Work in the Tri-State District," by Richard Jenkins, secretary of the Tri-State section of the American Zinc Institute; "Present Clinical Methods and Health and Sanitation Work in the Tri-State District," by Dr. F. V. Meriwether, surgeon, U. S. Bureau of Mines; "Prevention of Fall of Rock Accidents," by P. W. McNeely, safety engineer of the Federal Mining & Smelting Co.; "Prevention of Accidents During Shaft Sinking," by Dave Weir, safety engineer of the Vinegar Hill Zinc Co.; "The Prevention of Powder Accidents," by Henry W. Giessing, safety engineer of the Commerce Mining and Royalty Co.; "The Prevention of Haulage Accidents," by Erben Mabon, safety engineer of the Eagle-Picher Lead Co.; "The Total Incidental Cost of Minor Accidents," by O. N. Wampler, safety engineer of the Eagle-Picher Lead Co.; "A Brief Résumé of Accident Prevention Work in the Tri-State District," by R. V. Ageton, safety engineer of the Tri-State Zinc and Lead Ore Producers' Association.

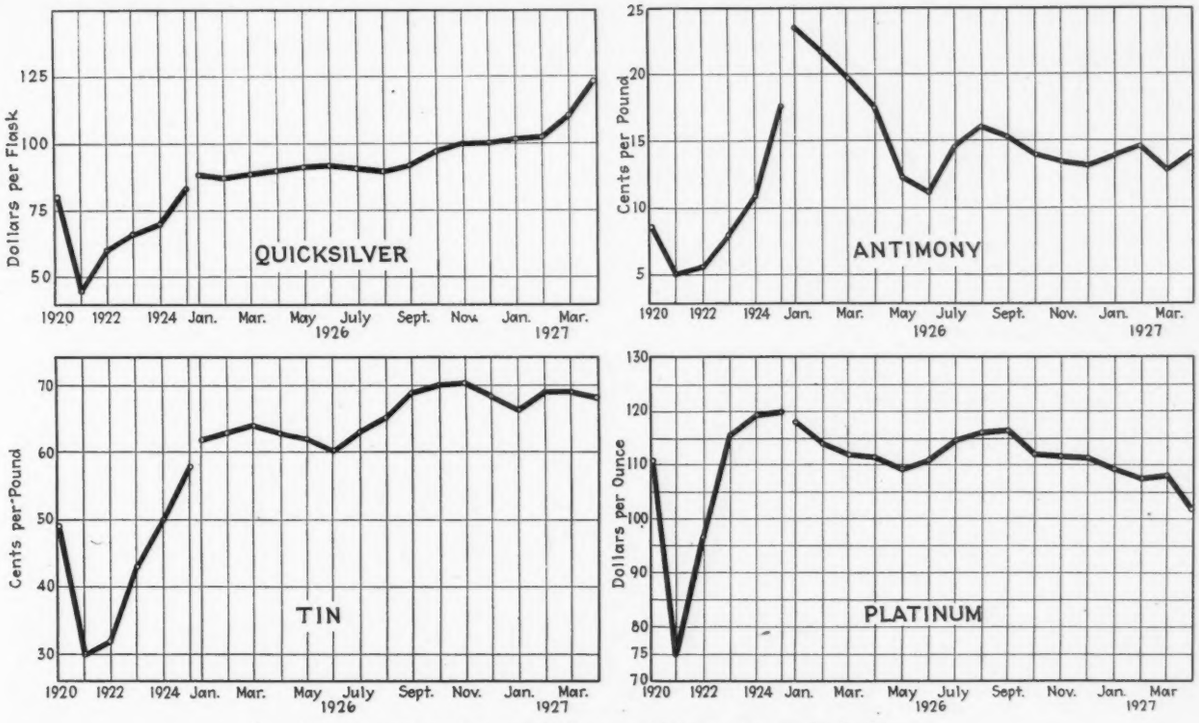
Market and Financial News

Interesting Situations Develop in Markets for

Quicksilver, Tin, Antimony, and Platinum

By A. B. Parsons
Associate Editor

MARKETS for the major non-ferrous metals—copper, lead, and zinc—manifestly are suffering from the fact that the current rate of consumption is not quite up to that of production. Buyers take advantage of their position, and prices droop. There is little that is obscure in this rather commonplace situation. On the other hand, the reasons for the position of several of the minor metals are not so evident and consequently are more interesting. Among these are quicksilver, tin, antimony, and platinum.



Average prices for quicksilver, antimony, tin, and platinum

Quicksilver Consumption Increasing

Quicksilver prices have been climbing steadily since 1921, and the last two months, as appears on the accompanying graph, have witnessed a decided jump. The current quotation is $125 per flask. An important cause of the steady increase may be the insistent demand by China, which for many months has been absorbing important amounts of quicksilver and quicksilver products. Consumption is said to be threefold: for ammunition, for medicinal supplies, and for making pigment for the national color. All of these purposes are associated with war. Fundamentally, however, the strength of the market lies in more varied industrial uses and the consequent increased consumption. In the United States, for instance, the estimated consumption in 1926 was about 36,000 flasks, compared to 29,800 in 1925, 16,547 in 1921, and 36,504 in 1918, the highest on record. A few of the uses that are comparatively new or that are taking increasing quantities are: manufacture of a compound to cultivate grass especially suitable for golf courses; making of caustic soda for use in the manufacture of artificial silk; manufacture of felt hats; supplying mercury boilers; use in curtain processes connected with petroleum refining; and the manufacture of automatic switches for iceless refrigerators and other electrical devices.

In spite of the increased price level and an import duty equivalent to $19.12½ per flask, domestic production declined from 9,174 flasks in 1925 to 7,645 in 1926. However, 1927 may see a reversal of this trend. The sources of about 90 per cent of the world's supply are the Spanish and Italian mines, all of which are under government control. The Spanish Government late in 1926 renewed its agreement to deliver the 1927 output to a syndicate at a price considerably higher than the former one, and the syndicate necessarily raised its prices at the same time. Clearly a working agreement between the French and Italian interests permits the fixing of the price at almost any level that seems expedient; and the possibility of seriously injuring the market is the principal deterrent to much higher prices. The Spanish mines will suspend operations during the summer months. However, this is a customary procedure, for the reason that the obsolete condensing equipment gives poor recoveries in warm weather. The market outlook for the domestic quicksilver producer seems good.

Tin Demand by Canneries Drops

Two consuming industries dominate the buying side of the tin market: canning of perishable products, principally foods, using tin plate; and automobile manufacture, using bearing metal and solder. Together they account for about two-thirds of the tin used in the

United States, which in turn consumes 65 per cent of the world's production. Automobile manufacturers are not so active as they were a year ago, and the expectation is that 1927 will be definitely behind 1926. Likewise, the situation in the food canning industry is bad. It appears that many millions of unsold cases of canned corn, peas and tomatoes have accumulated in the warehouses of packers. Two years' supply of peas is said to be in storage. Can manufacturers usually do not received payment for cans until they are not only filled but shipped, and apparently they have declined to provide more cans until the accumulation is reduced. Tin-plate mills had been operating at 95 per cent of capacity until April 1, but are now down to about 80 and may recede to 60 per cent or thereabouts. Some slackening is an annual occurrence, but this year it has come unusually early, and has been aggravated in extent by the canned vegetable situation.

Tin, however, differs from copper, lead, and zinc in that the price is not so sensitive to fluctuations in consumptive demand. Like mercury, the production branch of the industry is dominated by a few large interests (five or six private companies, in this instance) that are able to guide the market. Likewise, speculative dealings both in America and abroad are factors. Current production is about the same as in 1926, some decline in China being made up by increases elsewhere. The stock is low—the visible supply being about 13,500 long tons, of which 10,000 is afloat. Some recession in price may take place in coming months, but any marked decline is likely to be temporary. The curve on page 783 shows the steady upward course of the market since 1921.

Antimony Has Easy Market

That antimony, of which about 90 per cent comes from interior China, continues to drag is rather puzzling. The mines are about 900 miles inland from Shanghai, the exporting point, and a serious interruption of mine and smelter operation or of transportation to Hankow and thence to Shanghai would seem possible at any time, although late advices are to the effect that arrivals at Shanghai were normal up to April 1.

Two factors account in part for the easy market. Although bonded stocks in the United States amount to only from 1,000 to 1,200 tons, the large consumers probably have accumulated reserve stocks in their own plants, as a measure for affording economical insurance against developments in China that might cut off supplies and run the price skyward. Moreover, consumption is much less than it was a year ago. Storage-battery manufacturers are the largest single group of users; their business has been and continues to be unsatisfactory. A recession in automobile manufacturing, and the introduction of radio sets that do not require storage batteries, have decreased the market. Increased supply of secondary metal from reclaimed batteries has further lessened the demand for virgin antimony—and for lead, incidentally. Likewise, the increased production of antimonial lead has been a source of antimony.

The decline in the price of antimony from 23½c. in January, 1926, almost to 11c. in June was brought about by increased production stimulated by the high price reached in the latter part of 1925. Since then output and consumption have synchronized fairly well. Apparently any drastic change in the market position is contingent upon some important development in China.

Platinum Needs Control

Platinum is a peculiar metal in that a marked decline in price is not likely to stimulate the use of it—indeed the contrary effect is possible. The very high price discourages industrial uses; and no reduction that would permit it to compete with newly developed materials is at all likely. Primarily the market for platinum is to the manufacturer of jewelry. The desire of womankind for platinum jewelry is based largely on the fact that only the rich can afford it; and if the price were not prohibitive to much of the population, the market would dwindle. The only effective way to market a product of this kind is through the medium of a world syndicate similar to that which distributes diamonds, or at least with the close co-operation of a few interests that can control most of the world supply.

In general, this has been the status of the platinum industry, four or five important groups being the principal factors. Production from Russia, aggregating half or more of the world supply, found its way to the ultimate consumer through these channels. Recently, a change has been made and a Russian-American firm closely allied with the Soviet Government has undertaken to sell directly to consumers in America. It is understood that the recent demoralization of the market resulted from the offering at lower prices of an accumulation of metal, in addition to current production, by these American agents. Sales have been made at as low as $80, although the so called "official" price has been nominally $95. A contributing factor may have been the sale some time ago of a moderate quantity by a large electrical manufacturing company. Research had developed an alloy that could be substituted advantageously for platinum; and not only did the company discontinue buying, but it put reclaimed platinum on the market. One reason for the gradual decline since last September, shown on the accompanying graph, doubtless is the contribution of South Africa to the world's output, which began during the year.

The outcome of the present flurry is difficult to foresee. Jewelers prefer a comparatively high market, but they want it to be steady. Possibly a recovery to something like $110 will be effected; or, on the other hand, the price may eventually be stabilized at a lower level. It seems reasonable to predict that the Russian interests will limit their offerings to what the market will absorb, but it may take time to effect comparative equilibrium on a new basis. Unless the students of the market are wrong in their contention that a drastic price cut would not stimulate the aggregate consumption, a materially lower price level seems improbable.

Statistical Notes

Cerro de Pasco Copper Corporation reports for the year 1926 income totaling $28,603,810. Inventory of metals during the year decreased from $8,194,703 to $5,668,005, so that after paying $16,721,050 for operation, taxes, and custom ores, the balance to surplus was $9,355,060. In 1925 the corresponding figure was $10,337,615; but in that year inventories increased from $4,863,822 to $8,194,703.

Anaconda Copper Mining Co. reports for the year 1926 net income, after interest, taxes, and depreciation, amounting to $14,226,202, compared with $17,540,532 in the preceding year. A large factor in the decline in earnings, the report explains, is the shrinkage in the inventory value of the large quantities of metal on hand and in process, due to the much lower prices at the end of the year than at the beginning. Lower average prices realized on sales also were a factor. Gross income from sales and tolls amounted to $223,338,865, compared to $212,770,498 in 1925; and operating profit combined with income from investments amounted to $29,371,916, compared to $33,077,229 in the previous year.

Tonopah Mining Co. of Nevada reports net earnings for the year 1926 as $263,064. This came from the milling of 57,572 tons of ore for a net recovery of 1,343,509 oz. of silver and 15,404 oz. of gold. After paying cash dividends of $150,000 the company had a surplus as of Dec. 31 of $2,627,994.

Nipissing Mining Co. reports the following as the result of its operations for the year 1926:

Silver produced, oz.	2,985,649
Net value	$1,853,538
Cost, per ton ore	11.814
Cost, per ounce silver	0.51475
Net profit for year	164,310

Negociacion Minera de San Rafael y Anexas during 1926 produced 4,152,439 oz. of silver and 13,331 oz. of gold from 273,433 metric tons of ore. The sum of 991,321 pesos was added to the profit-and-loss account, and dividends totaling 880,000 pesos were paid. On the company's balance sheet the mines at Pachuca, Parral, and elsewhere in Mexico have been entirely written off, as have the milling and hydro-electric plants owned by the company. Assets amounting to 1,744,172 pesos consist mostly of unsold bullion, warehouse supplies, and cash.

Texas Gulf Sulphur Co. reports for the quarter ended March 31, 1927, net income of $2,854,631 after depreciation and federal taxes, but before depletion. This compares with $1,930,624 in first quarter of 1926.

Magma Copper Co. during the three months ended March 31 produced 7,386,059 lb. of copper at a cost of 7.58c. per pound after crediting gold and silver but before providing for depreciation and federal taxes. This compares with 7.903c. for the entire year 1926.

The Market Report

Copper Dips Below 13c.—Lead Prices Cut—Little Change in Zinc and Tin

New York, May 4, 1927 — Dullness continues to be the outstanding characteristic of the non-ferrous metals in the domestic market. In spite of this prices have remained comparatively firm. This applies to each of the metals except lead, in which business has been done in moderate volume, apparently stimulated by lower prices. In general the situation seems to be that buyers are confident that their current needs can be met without difficulty and that there is no occasion for buying ahead. Most of the light business in both copper and zinc was for May shipment, a fact which tends to substantiate this view. Though the principal copper producers have held firmly at 13c., some sales have been made at concessions all week, and the market cannot be quoted at the even 13c. delivered in the East. Today lead in New York is obtainable at a slight concession under the Smelting company's price of 6.75c.; the prevailing quotation in the St. Louis market is 6.40c. Zinc has been fairly steady at 6.125c., or a trifle under, all week. Tin has been quiet, with prices fluctuating within narrow limits.

Silver fared slightly better in New York than in London, closing the week at 56¼c., an advance of ¼c. over the close of a week ago. The market for platinum and palladium continues in a demoralized state. Offering prices have been slashed, but this has simply served to frighten buyers, and business has been exceedingly light. Quoted prices are to a large extent nominal. Antimony continues dull, with prompt metal quoted at 13⅛c., New York, duty paid. Quicksilver is quiet but firm.

Daily Prices of Metals

April May	Copper	Tin		Lead		Zinc
	Electrolytic, N. Y.	99 Per Cent	Straits	N. Y.	St. L.	St. L.
28	12.725@12.775	64.375	66.75	6.85	6.475@6.50	6.125
29	12.725@12.775	63.75	66.00	6.85	6.475	6.125
30	12.775	63.875	66.125	6.85	6.475	6.125
2	12.775	64.625	67.00	6.75	6.425	6.125
3	12.725@12.775	64.125	66.875	6.725@6.75	6.40	6.10@6.125
4	12.725@12.775	64.50	67.375	6.725@6.75	6.40	6.10@6.125
	12.758	64.208	66.688	6.796	6.444	6.121

Average prices for calendar week ending April 30, 1927, are: Copper, 12.765c.; 99 per cent tin, 64.167c.; Straits, 66.563c.; N. Y. lead, 6.902c.; St. L. lead, 6.519c.; zinc, 6.123c.; and silver, 55.854c.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis: i.e., delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.

Quotations for copper are for ordinary forms of wire bars, ingot bars, and cakes. For ingots an extra 0.05c. per pound is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

April May	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
28	54 11/16	55¼	61¼	295½	290	25 11/16	26¼	29 5/16	29 7/16
29	54 9/16	55 1/16	61	294	287½	25 9/16	26 1/16	29⅛	29¼
2	54 9/16	55 1/16	61	298¾	289⅞	25⅞	26⅜	29⅜	29⅝
3	54⅜	55	61⅜	297	288¾	25⅜	26 5/16	29⅛	29½
4	54 7/16	55 1/16	61¼	296¼	288	25 11/16	26 3/16	29 3/16	29 7/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Apr.	Sterling Exchange "Checks"	Silver		Gold London	May	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
28	4.85¼	55⅞	25⅞	84s11½d	2	4.85¼	55¾	25¾	84s11½d
29	4.85¼	55¾	25¾	84s11½d	3	4.85⅜	56⅛	25 15/16	84s10½d
30	4.85¼	55⅝	25 11/16	.....	4	4.85½	56¼	25⅞	84s11d
				Avg.			55.896		

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Average Metal Prices for April, 1927

Copper:	
New York Electrolytic	12.808
London Standard Spot	55.056
London Electrolytic Spot	61.526
Lead:	
New York	7.126
St. Louis	6.807
London Spot	26.546
London Forward	27.053
Silver:	
New York	56.399
London	26.136
Sterling Exchange	485.178
Zinc:	
St. Louis	6.338
London Spot	29.579
London Forward	29.901
Tin:	
99 per cent	66.069
Straits	67.933
London	302.572
Quicksilver	123.250
Antimony	14.166
Platinum:	
Refined	101.885
Crude	91.865
Aluminum, 98 per cent	26.000

Copper Buyers Apparently Await Release of April Statistics

With one or two exceptions the past week has seen the dullest copper market in two or three years. Buyers presumably are awaiting the publication of the statistics for April to see whether or not the curtailment of output indicated by the March figures actually materialized. Producers generally are in a fairly comfortable position, and they are apparently confident that the statistics will show a marked reduction both in mine production and in stocks of refined metal. Shipments from all the refineries were unusually large during April, probably in consequence of the heavy buying wave of February, and this together with a somewhat diminished intake of blister, should result in a sizable decrease in refinery stocks. The gossip specifies 10,000 tons for the decline in refined and blister combined.

Except for a few sales of moderate tonnage by first-hands and one or two by second-hands, the business of the week was placed at 13c. in Connecticut and 13.125c. at Middle West points. The bargain prices are reflected in the quotations only because of the extremely light sales by the producers who maintained the 13c. price. Foreign business

has been fair, the export price being 13.35c. c.i.f. all week. Some f.a.s. orders were placed at 13.05c. and 13.10c.

Lead Price Cuts Stimulate Demand

On April 28 the American Smelting & Refining Co. reduced its New York contract price from 7 to 6.85c., and on Monday, May 2, a further reduction to 6.75c. was announced. The London market has shown a little more strength than in the past, spot lead in that market declining only 2s. 6d. following each decline in New York. Though the market is comparatively quiet today, there seems less likelihood of further cuts in price than there was a week ago. It might be possible to pick up odd lots of lead at 5 or 10 points less than the Smelting company's price, but such sales, if made, have been of small moment. A concession of 2½ points has been made, however, on a fair tonnage.

Yesterday and today, 6.40c., St. Louis, was generally quoted, with fair business at that level. Storage-battery manufacturers continue out of the market, but other consumers are taking modest tonnages. It is notable that producers are booking orders for delivery as far ahead as July at the current prices; ordinarily they are unwilling to quote further ahead than six weeks.

Corroding grades of lead command the usual premium of $2@$3 per ton.

Statistics of production and consumption for April are not expected to bull the market. It is doubtful if domestic production was curtailed materially, if at all, last month; May production, however, promises to be a little less than April. Foreign demand is expected to develop in sufficient volume to support the market in a measure at least.

Zinc Quiet and Steady

Prime Western zinc has been sold in limited quantities during the week at prices ranging from 6.10c. to 6.15c., East St. Louis. Zinc ore in the Joplin market has declined to $40 per ton, at which price current sales are around 12,000 tons per week against a production only slightly under 15,000 tons. Talk of curtailment in production is heard in various quarters, both by the mines and smelters. However, to be effective a drastic cut probably would have to be made in Joplin. The Far Western zinc districts are contributing increasing amounts to domestic production, so that Joplin does not dominate the situation as decisively as it once did. High-Grade is quiet, with 8c. asked for delivered metal in the New York district.

Tin Holds Fairly Well

The tin market has been quiet all week, though there has been a moderate business on some days in metal for early delivery. Demand for futures has not amounted to much, though the more distant deliveries have been obtainable for from 1¾ to 2¾c. less than prompt. The 99 per cent grades continue at an unusual discount, a slack demand from automobile manufacturers perhaps being responsible; prices here represent no profit over import costs from England.

Sterling Exchange Up

Sterling exchange went to a new high for the year yesterday, closing cable quotations being $4.85 13/16. There is little change in most other foreign monies. Closing cable quotations on Tuesday, May 3, were as follows: francs, 3.91¾c.; lire, 5.26c.; and marks, 23.70c. Canadian dollars, 3/32 per cent premium.

Silver 56¼c. and Firm

During the first half of the week the London silver market eased off slightly, and during this period New York followed the easier trend, with rates slightly above London parities. Though London quotations eased off at the close, the New York market is firmer, as a result of heavy demand on account of short covering.

Mexican Dollars (Old Mexican pesos): April, 28th, 42⅜c.; 29th, 42¼c.; 30th, 42¼c.; May 2d, 42¼c.; 3d, 42⅝c.; 4th, 42⅜c.

Zinc-Lead Prices Again Lowered

Joplin, Mo., April 29, 1927

Blende	
High	$44.30
Premium blende, basis 60 per cent zinc	$41.00@42.00
Prime Western, basis 60 per cent zinc	40.00
Fines and slimes, 60 per cent zinc	39.00@37.00
Average settling price, all zinc	41.28
Galena	
High	$93.70
Basis 80 per cent lead	87.50
Average settling price, all lead	91.05

Shipments for the week: Blende, 15,782; lead, 2,560 tons. Value, all ores the week, $884,520.

During the past two weeks five mine mills and one tailing mill have resumed, and nine mine mills and one tailing mill were closed down, according to a report issued by the Tri-State Zinc and Lead Ore Producers' Association. Federal Lead Co.'s Kansuri mine, not included above, is reported closed down for an indefinite period by the Miami *News-Record*, which adds: "There are rumors that many mines will be closed down within the next two weeks."

Sellers are no longer making an effort to withhold either zinc or lead from the market. Lead stocks have been lowered from more than 12,000 tons to 8,600 tons. With this week there was begun a lowering of zinc stocks.

Unlike former periods of price depression, the local papers are making no long and concerted appeal to producers to restrict the output, but one after another of those mines that cannot show a margin of profit in marketing concentrates on the present decline of prices are being closed.

Platteville, Wis., April 30, 1927

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$43.75
Lead Ore	
Lead, basis 80 per cent lead	$87.50

Shipments for the week: Blende, 1,241 tons; lead, none. Shipments for the year: Blende, 22,222; lead, 640 tons. Shipments for the week to separating plants, 2,807 tons blende.

Shipments for four months: Blende, 238,431; lead, 39,641 tons. Value, all ores four months, $14,199,110.

Steel Demand Declines

Prices of Fabricated Forms Generally Lower—Pig Iron and Coke Quiet

Pittsburgh, May 2, 1927

Steel buying has dropped off farther, the market in the last week showing a volume well below that of March. Production has been following sales on their down grade, but at a distance. With steel production at about an 85 per cent rate in the last week, against a 94 per cent rate in March, the 10 per cent decrease in tonnage is decidedly less than the decrease in sales, and further decreases in production are in prospect. It seems probable that last year's 16 per cent decrease in steel production from March to July will be exceeded this year. A 25 per cent decrease would make a 70 per cent rate next July, and the precedent of three successive years would suggest an upturn then.

Pig Iron.—Several sales of Valley basic pig iron have been made at $18.50, putting the market back to the level occupied before the curious 50c. advance of a month ago. Buying is light in all grades. Bessemer, $19.50; basic, $18.50; foundry, $18.50@$19, f.o.b. Valley furnaces.

Connellsville Coke.—There has been no striking thus far in the Connellsville region, and operations have been decreasing on account of poor demand, whereby chances of strikes are somewhat diminished. Spot furnace coke has declined farther, with sales at $3, small lots sometimes commanding $3.10 or $3.15. Spot foundry remains at $4.25@$4.75.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

Aluminum—Per lb., 99 and 98 per cent grades, price of leading interest, 26c.; outside market, 25.30@25.80c. Consumption steady. London, 98 per cent, £105@£107 per long ton for domestic consumption.

Antimony—Per lb., duty paid, spot: Chinese brands, range for week, 14⅝@13¾c.; futures same. Little interest shown. Cookson's "C" grade, spot, 18c.

Chinese needle, lump, 8c. Standard powdered needle, 200 mesh, 10c. White oxide, Chinese, 99 per cent Sb_2O_3, 16½c. Nominal.

Bismuth—Per lb., in ton lots, $2.20@$2.25. London, 8s.

Cadmium—Per lb., 60c. London, 1s. 10d. for Australian metal.

Cobalt—F.o.b. Canadian works, per lb., shot, 96@98 per cent, $2.50. Black oxide, 70 per cent, $2.10. London, 8s. 6d.@10s. for metal; 8s. for black oxide; 8s. 10d. for gray.

[1]**Germanium Oxide**—Per gm. in 300- to 500-gm. lots, $5.

Iridium—Per oz., $112@$115 for 98@99 per cent sponge and powder. London, £32½ in iridio-platinum; £17@£19, nominal, for sponge and powder.

[1]**Lithium**—Per lb., 95@96 per cent grade in 1- to 5-lb. lots, $65.

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[1]Price furnished by Foote Mineral Co., Philadelphia.

Magnesium—Per lb., in ton lots: 8-lb. ingots (3x3x15 in.), 75c.; 3-lb. sticks (1⅛x33 in.), 80c.; 10-oz. sticks, (1x12 in.), 90c. Market firm. Good demand reported for light alloys. London, 3s. 9d.@4s. 3d. for 99 per cent ingots or sticks.

[1]**Molybdenum**—Per kg., 99 per cent, $25; C. P. metal, $80.

Monel Metal—Base price for shot, 32c. per pound.

Nickel — Per lb., ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade), for single lots of spot metal. London, £170@£175 per long ton according to quantity. Demand continues good.

Osmium—Per oz., $55@$60; London, £15@£18.

Palladium—Per oz., $53@$57. Small lots bring up to $62. Pure metal as a constituent of crude platinum, $48@$52 per oz. London, £11@£12, nominal.

Platinum — Official price on refined metal cut to $95 per oz. on April 28. Open market cash sales of large lots at $80@$85. Pure metal as a constituent of crude platinum, nominal. Market still unsettled.

London, £19@£19½ per oz., for refined, and £17@£17½ for crude and scrap. Quiet.

Quicksilver—Per 75-lb. flask, $124@$125. San Francisco wires $124.33. London, firm at £22 15s.@£23.

Radium—Per mg. radium content, $70.

Rhodium — Per oz., $55; London, £9½@£13. Nominal.

Ruthenium — Per oz., $40, nominal. London, £7½@£10.

Selenium — Black, powdered, amorphous, 99.5 per cent pure, $1.90@$2 per lb. in ton lots. London, 7s. 6d.@7s. 8d.

Tantalum—Bar and heavy sheet, chemically pure, $200 per kg. in lots of 1 kg. or over. Less than kilogram lots. $250 per kg. Market firm. Use of metal in industry increasing.

Tellurium—Per lb., $2.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $15 per lb. in 25-lb. lots.

Tungsten Powder—Per lb., 97 to 98 per cent pure, $1.05.

[1]**Zirconium Metal**—Per lb., 98 per cent grade, $15 in 5- to 10-lb. lots.

Metallic Ores

Chrome Ore—Per long ton, f.o.b. eastern shipping points, $23@$24 for 45 to 50 per cent Cr_2O_3 ore. Prices firm.

Iron Ore—Lake Superior ores, per long ton, lower Lake ports; prices have been reaffirmed for the coming season.

Mesabi, non-bessemer, 51½ per cent iron, $4.25. Old Range, $4.40.

Mesabi, bessemer, 51½ per cent iron, $4.40. Old Range bessemer, 51½ per cent, $4.55.

Eastern ores, cents per unit, delivered at furnaces; Foundry and basic, 53 to 63 per cent, 9@10½c.

Foreign ores, f.o.b. cars Atlantic ports, cents per unit:

Swedish and Norwegian, low-phosphorus, 68 per cent, 10½@10¾c.

Spanish low-phosphorus, 52@54 per cent, 11c.; nominal.

Algerian, low-phosphorus, 10½@11½c.

Spanish foundry or basic, 50@54 per cent; nominal.

Swedish foundry or basic, 66@68 per cent, 9½c.

Manganese Ore—Per long ton unit of Mn, c.i.f. North Atlantic ports, minimum 47 per cent Mn, 36@38c. Caucasian (washed), 53@55 per cent, 38@40c.

[1]Chemical grades, powdered, coarse or fine, 82@87 per cent MnO_2, Brazilian and Cuban, $70@$80 per ton in carloads.

Molybdenum Ore—Per lb, of MoS_2, for 85 per cent MoS_2 concentrates f.o.b. Denver, Colorado, 50c.

Tantalum Ore—Per pound of Ta_2O_5, based on 63 per cent material, 80c. c.i.f. New York. For each 1 per cent of Ta_2O_5 above 63 per cent a bonus of 1c. per pound is paid, and, similarly, a deduction of 1c. per pound is made for each 1 per cent of Ta_2O_5 below 63 per cent.

Titanium Ore—Illmenite, 52 to 60 per cent TiO_2, f.o.b. Atlantic seaboard, $10@$18 per gross ton, according to grade and impurities. Low-grade domestic, 32 to 35 per cent, about $7@$8 per gross ton. Rutile, 96 per cent concentrate, 11c. to 13c. per lb.

Tungsten Ore—Per unit of WO_3, N.Y.: Wolframite, $10.50@$10.75; Western scheelite, $11@$11.25.

Uranium Ore—Minimum 5 per cent U_3O_8 per lb. of U_3O_8 contained, nominal at $5, f.o.b. Montrose, Colo.

Vanadium Ore — Containing 5 per cent V_2O_5, nominal at 25c. per lb. of V_2O_5, f.o.b. Montrose, Colo.

Foreign concentrate (lead vanadate) 12 to 18 per cent V_2O_5, 55@60c. per lb. V_2O_5, duty paid, seaboard. Nominal.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and seller.

[1]**Amblygonite**—8@9 per cent lithium oxide, $50@$60 per ton, f o.b. mines.

Asbestos—F.o.b. *Quebec* mines, tax and bags included, per ton:

Crude No. 1, $525; crude No. 2, $325; spinning fibers, $200; magnesia and compressed sheet fibers, $125@$165; shingle stock, $70@$80; paper stock, $40@$45; cement stock, $25; short fibers, $10@$17.50; floats, $15. Magnesia fiber is in good demand at advanced prices. Shingle stock in heavy demand. Grades lower than shingle abundant.

No. 1 Rhodesian crude, $400; No. 2, $325@$350 per ton, c.i.f. New York.

Barytes—F.o.b. mines, bags extra:

Georgia: Barytes ore, crude, per long ton, $7.25@$7.50. Wet ground, off-color, $12@$18, depending on analysis. Good demand at present.

Missouri: Water ground and floated, bleached, $23; $25 in less than car lots, f.o.b. works. Crude ore, 93 per cent $BaSO_4$, not to exceed 1 per cent iron, per ton, $8, f.o.b. mines. Market good.

Bauxite—No. 1 chemical ore, over 60 per cent Al_2O_3, less than 5 per cent SiO_2, and less than 2 per cent Fe_2O_3, $8 per long ton, f.o.b. Georgia mines.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Foreign, per metric ton, c.i.f.: Dalmatian, low SiO_2, $5@$6.50; Istrian, $5.50@$7; French, red, $6@$7.50.

Borax—Carload lots, in bags, per lb.: crystals, 4¼c.; granulated or powdered, 4c.; f.o.b. plant, *Pennsylvania*.

[1]**Celestite**—90 per cent $SrSO_4$, finely powdered, $27 per ton in carload lots.

Chalk—Crude, in bulk, per ton c.i.f. New York, $4.75@$5.

China Clay (Kaolin)—F.o.b. *Virginia* mines, per ton; crude, lump, No. 1, $7; crude No. 2, $5.50; washed, $8; powdered and air-floated, $10@$15; ground, $7@$10.

Florida, pressed pottery, bulk, $13; ground, No. 1, $20; No. 2, $15. Sprayed mineral flour No. 1, $20; No. 2, $17.

1A grades, domestic, $16@$18, f.o.b. Delaware plants. Good demand.

Imported English, f.o.b. American ports: Lumps, $13@$21; powdered, $45@$50.

Diatomite—Per short ton, f.o.b. plant: Kiln-fired brick, $65; kiln-fired aggregate, ¼ in., $45; insulating powder, $30; natural aggregate, ¼ in., $20; air-floated powder, $40. Over 85 per cent silica, 98 per cent through 200 mesh, $15@$16, depending on quantity. Market good.

Emery — F.o.b. *Pennsylvania* and *New York* in 350-lb. kegs, per lb.: Greek Naxos, 6½c.; Turkish, 6½c; Khasia, 5½c.; domestic, 3½@4c. Market fair.

Feldspar—F.o.b. mine or grinding plant:

North Carolina: No. 1 pottery grade, $6@$7.50 per long ton. Market good.

New Hampshire: Pottery grade, $8.25 per ton; soap grade, $8.75.

New York: Per ton, f.o.b. cars, No. 1 crude, $9. Market fair.

Tennessee: No. 1, pottery, 140 mesh, $16 per ton; 200 mesh, $18. No. 2, enamel, 140 mesh, $14; 200 mesh, $16.

Maine: Pottery grade, ground, $19 per ton. Market good.

Fluorspar—F.o.b. *Kentucky* and *Illinois* mines, per short ton:

Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $18. Foundry lump, 85-5, $20. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $32.50 in bulk; $36.50 in bags or barrels. Acid lump, 98-1, $30 in car lots. Market inactive.

New Mexico: 85-5 gravel, $16.50; 85-5 lump, $16.50; 93-3 lump, $19; 96-3, ground 100 mesh, $35, bulk; $40 bags. Market good.

Foreign spar, duty paid, $16.75@$17.25, tidewater.

Fuller's Earth — Per ton, f.o.b. *Florida:* 16 to 30 mesh, $16.50; 30 to 60 mesh, $18; 60 to 100 mesh, $15; 100 mesh up, $8; 200 mesh up, $15. Market fair at unchanged prices.

Powdered, import, duty paid, $24@$25 per ton.

Garnet — Domestic, per ton, f.o.b. mines, $85. Market easy.

Spanish grades, $60, c.i.f. port of entry.

Gilsonite—Per ton, carload lots, f.o.b. mines *Colorado:*

Selected grade, $33; seconds (mine run), $25.50.

Graphite—F.o.b. *New York*, per lb:

Ceylon lump, 8½@9c.; chip, 7½@8c.; dust, 3@5; Madagascar flake, 6½@7½c. Market quiet.

No. 1 flake, 10c. up; fine flake, 8c. up. Foundry facings, 4c. up. Amorphous, fine ground, 3c. up; fine ground crystalline, 5c. up. Crude amorphous graphite, $15@$35 per ton, according to grade. Market dull.

Greensand—Per ton, f.o.b. cars, *New Jersey:* Screened and bagged, best grade in carload lots, $25. Demand good.

Gypsum—Per ton f.o.b. mill, depending upon location: Crushed, $2.75@$3; ground, $4@$10; agricultural, $6@$15; calcined, $8@$10.

Iron Oxide (See Ocher)—Standard Spanish red, 2¾@4c. per lb.; domestic earth, 2@4½c.

Kaolin—See China Clay.

[1]**Lepidolite** — $20@$30 per ton for ordinary grades. Nominal.

Limestone — F.o.b. shipping points, depending on location; either lump or crushed, 75c.@$2 per ton.

Agricultural, 75c. up to $4 or $5 for crushed or pulverized. Prices depend upon source, purity, and fineness.

Magnesite — Per short ton, f.o.b. *California* mines: Grade "A" calcined, 80 per cent through 200 mesh, $40; grade B, $38; dead burned, $33; crude, $14. F.o.b. eastern seaboard, calcined, $40. Market fair.

Mica—F.o.b. plant, per ton:

New Hampshire: Mine run, $360; clean shop scrap, $25; mine scrap, $20. White dry ground, 20 mesh, $28; 40 mesh, $35; 60 mesh, $55; 100 mesh, $70; 200 mesh, $85. Good demand, particularly for finer meshes of ground material.

North Carolina: White, ground, 20 mesh, $35; 70 mesh, $100.

Madagascar, amber, dark, free from iron, per lb., f.o.b. *New York*, duty paid: No. A1, $3.50@$3.75; No. 1, $3.25; No. 2, $3.10@$3.15; No. 3, $1.60; No. 4, 95c.; No. 5, 48@54c. Strong market on account of cyclone destroying port of shipment (Tamatave) in Madagascar. Demand strong, especially for Nos. 2, 3 and 4 grades. Supplies low.

[1]**Monazite**—Minimum 6 per cent ThO_2, $120 per ton.

Ocher—F.o.b. *Georgia* mines, per ton: $22.50@$25 in sacks; $25@$30 in barrels; washed and water floated, $22@$25; second grade, 99 per cent through 225 mesh, $18. Market fair.

Phosphate—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7; 75 per cent, $6.25; 74@75 per cent, $6; 70 per cent, $4.50; 68 per cent, $4.10; 66 per cent, $4. Prices firm.

Florida, pebble domestic: 76@77 per cent, $6; 75 per cent, $5.25; 74@75 per cent, $5; 72 per cent, $4; 70 per cent, $3.50. Market dull and prices easy, on account of small buying by fertilizer manufacturers.

Tennessee, ground, 95 per cent through 100 mesh, basis 65 per cent B.P.L. (tri-calcium phosphate), $8 per short ton, with unit differential of 20c. per ton. Market slow. Brown lump for acid manufacturers, per gross ton, $5.75 on 75 per cent basis; $4.50 for 72 per cent basis.

Potash—The ruling contract prices are as follows:

	Bags	Bulk
Muriate of potash 80 @ 85 per cent, basis 80 per cent...	36.40	34.80
Sulphate of potash 90 @ 95 per cent, basis 90 per cent....	47.30	45.70
Sulphate of potash-magnesia 48@53 per cent, basis 48 per cent	27.25	25.85
Manure salt 30 per cent....	21.75	18.75
Manure salt 20 per cent....	15.40	12.40
Kainit 14 @ 16 per cent....	12.50	9.50
Kainit 12.4 per cent.....	12.00	9.00

Two thousand pounds net weight, c.i.f. Atlantic and Gulf ports. German weights, tares and analyses. Although the guarantee against price declines of both the German and French syndicates expired April 30, producers' representatives have not announced whether there will be any immediate change in quotations.

Discounts: 5 per cent on minimum of 50 tons K_2O; 6 per cent on 100 tons; 7 per cent on 300 tons; 10 per cent on 500 tons.

Pumice Stone — In barrels, per lb., powdered, 2½@4c.; selected lumps, 5@7c.

Pyrites—Tharsis, per long-ton unit of sulphur, c.i.f. U. S. ports; guaranteed 48 per cent sulphur, furnace size, 2½-in. diameter, 13¾c. Same price for fines screened through ½-in. mesh. Cinder from ore to remain property of buyers. Market improving.

[1]**Quartz Rock Crystals** — Colorless, clear and flawless, pieces ¼ to ½ lb. in weight, 40c. per lb. in ton lots. For optical purposes, double above prices.

Silica—Water ground and floated, per ton in bags f.o.b. Illinois: 400 mesh, $31; 350 mesh, $26; 250 mesh, $18. Market fair.

Glass sand, f.o.b. producing plant, 75c.@$5 per ton; molding sand, 65c.@$3.50; blast sand, $1.35@$3.50.

[1]**Spodumene**—$20@$30 per ton, depending upon lithium content. Nominal.

Sulphur—$18 per ton for domestic, f.o.b. Texas mines; $22 for export, Atlantic ports. Prices in reality are on a c.i.f. basis, but the average price reduced to an f.a.s. figure is about as given. Good shipment against contracts. Open prices $1 higher than above.

Talc — Per ton, carload lots, f.o.b. works, containers included:

Vermont: 99 per cent through 200 mesh, extra white, $10.50; 96 per cent through 200 mesh, medium white, $9.50; packed in 50-lb. paper bags. Market somewhat firmer. Demand firmer but uneven. Competition active.

New York: Double air-floated, 200 mesh, $13.75; 325 mesh, $14.75 Demand fair.

Georgia: Powdered, gray, $7.50@$10; yellow, $9@$12; red, $11@$13; roofing, $7.50@$9 Market fair.

New Jersey: Soapstone, ground, $10@$12; market good.

Tripoli—Per short ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. Missouri: Once ground through 40 mesh; rose and cream colored, $14. Double ground through 110 mesh; rose and cream, $17. Air-floated through 200 mesh; rose and cream, $25; mill run, $15. Business fair.

[1]**Zircon**—95 per cent, 3c. per lb., f.o.b. mines, in carload lots.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Mineral Products

Arsenious Oxide (white arsenic)—3¾c. per lb. London, £17 per long ton for Cornish white.

Calcium Molybdate—$1.20 per lb. of contained Mo, delivered.

Copper Sulphate (blue vitriol)—4.95c. @5.15c. per lb., depending on quantity, for either large or small crystals. Good demand from Mexico and South America.

Sodium Nitrate—Crude, per 100 lb., ex vessel, Atlantic ports, $2.60 for spot; future delivery, $2.60.

Sodium Sulphate (Salt Cake)—Per ton, bulk, f.o.b. works, $18@$20.

Zinc Oxide—Per lb. in bags, in car lots: Lead-free, 6⅝c.; 10, 20 or 35 per cent leaded grades, 6¾c.; French red seal, in bags, 9¾c.

Ferro-Alloys

[1]**Ferrocerium**—Per lb., $5.50.

Ferrochrome—Per lb. of contained chromium, 60@70 per cent chromium, 4 to 8 per cent carbon, 11½c. Market active.

Ferromanganese—Domestic and foreign, 78@82 per cent, $95 per gross ton furnace, for delivery during first half of 1927. Spiegeleisen, 19@21 per cent, $37 on carload business, f.o.b. furnace; 16@19 per cent, $34. Regular consumers covered for first half.

Ferromolybdenum—Per lb. of Mo, f.o.b. shipping point, 50@60 per cent Mo, $1.25 on contract; $1.30 for spot.

Ferrophosphorus—Per ton, 18 per cent P, $91; electrolytic, 24 per cent, $122.50; f.o.b. *Alabama* and *Tennessee*.

Ferrosilicon—Per gross ton, f.o.b. works, freight allowed on carload lots east of Mississippi River: 50 per cent, $85; 75 per cent, $145; 14@16 per cent, $45. Active market.

Ferrotitanium—For 15 to 18 per cent material, $200 per ton, f.o.b. Niagara Falls, N. Y.

Ferrotungsten—Per lb. of W contained, 75@80 per cent W, 98c. to $1.05, f.o.b. works. Slow and spotty.

[1]**Ferro-uranium**—30 to 40 per cent U, $4.50 per lb. of U contained, f.o.b. works in 500-lb. lots.

Ferrovanadium—Per lb. of V contained, f.o.b. works, $3.15@$3.75, depending on grade. Market active.

Metal Products

Rolled Copper—Sheets, 21¾c.; wire, 15@15½c. per lb., f.o.b. mill.

Lead Sheets—Full rolled, 10½c. per lb.; clipped, 10¾c.

Nickel Silver—28¾c. per lb. for 18 per cent nickel Grade A sheets.

Yellow (Muntz) Metal — Dimension sheets, 19½c. per lb.; rods, 16½c. per lb.

Zinc Sheets—9¾c. per lb., f.o.b. works.

Refractories

Chrome Brick—$45 per net ton, f.o.b. shipping point.

Fireclay Brick—First quality, $40@$43 per M., Ohio, Kentucky, Central Pennsylvania; second quality, $35@$40.

Magnesite Brick—9-in. straights, $65 per net ton, f.o.b. works.

Silica Brick—$43 per M., Pennsylvania and Ohio; $50 Alabama and Illinois.

[1]**Zirkite**—Powdered, 80 per cent ZrO_2, 3c. per lb. Brick, straights, 80c.@$1 each.

Metal Statistics

Monthly Average Prices of Metals

Silver

	New York		London Spot		Sterling Exchange	
	1926	1927	1926	1927	1926	1927
January	67.795	55.795	31.322	25.863	485.295	484.775
February	66.773	57.898	30.797	26.854	485.852	484.551
March	65.880	55.306	30.299	25.655	485.606	484.887
April	64.409	56.399	29.682	26.136	485.702	485.178
May	65.075	.....	30.125	.....	485.485	.....
June	65.481	.....	30.248	.....	486.000	.....
July	64.793	.....	29.861	.....	485.755	.....
August	62.380	.....	28.773	.....	485.293	.....
September	60.580	.....	27.904	.....	484.845	.....
October	54.505	.....	25.291	.....	484.475	.....
November	54.141	.....	25.192	.....	484.359	.....
December	53.466	.....	24.733	.....	484.553	.....
Year	62.107	.....	28.686	.....	485.268	.....

New York quotations, cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York Electrolytic		London Spot Standard		London Spot Electrolytic	
	1926	1927	1926	1927	1926	1927
January	13.822	12.990	59.013	55.414	65.325	62.375
February	13.999	12.682	59.669	54.438	66.375	61.119
March	13.859	13.079	58.603	55.935	65.489	62.641
April	13.706	12.808	57.200	55.056	64.600	61.526
May	13.599	.....	56.494	.....	64.313	.....
June	13.656	.....	56.778	.....	64.591	.....
July	13.924	.....	57.864	.....	65.625	.....
August	14.174	.....	58.857	.....	66.857	.....
September	14.062	.....	58.705	.....	66.528	.....
October	13.862	.....	58.304	.....	66.298	.....
November	13.576	.....	57.293	.....	65.551	.....
December	13.302	.....	56.869	.....	64.114	.....
Year	13.795	.....	57.971	.....	65.472	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London			
	1926	1927	1926	1927	1926 Spot	1926 3 Mos.	1927 Spot	1927 3 Mos.
January	9.255	7.577	9.102	7.392	34.778	34.584	27.485	27.786
February	9.154	7.420	8.991	7.286	33.903	33.903	27.344	27.781
March	8.386	7.577	8.165	7.328	31.625	31.921	27.845	28.302
April	7.971	7.126	7.764	6.807	28.775	29.284	26.546	27.053
May	7.751	.....	7.538	.....	28.253	28.719	.....	.....
June	8.033	.....	7.876	.....	29.986	30.142	.....	.....
July	8.499	.....	8.383	.....	31.716	31.545	.....	.....
August	8.908	.....	8.722	.....	32.756	32.345	.....	.....
September	8.786	.....	8.515	.....	32.085	31.790	.....	.....
October	8.402	.....	8.130	.....	30.821	30.696	.....	.....
November	8.005	.....	7.800	.....	29.270	29.563	.....	.....
December	7.855	.....	7.688	.....	28.932	29.264	.....	.....
Year	8.417	.....	8.223	.....	31.075	31.145	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York				London	
	1926	1927	1926	1927	1926	1927
	99%		Straits		Spot	
January	61.415	64.785	62.275	66.415	282.038	297.804
February	62.653	66.528	63.705	69.142	287.107	306.125
March	63.472	67.833	64.505	69.199	292.288	313.315
April	61.962	66.069	63.389	67.933	281.388	302.572
May	60.165	.....	62.305	.....	270.125	.....
June	58.409	.....	60.611	.....	268.352	.....
July	61.365	.....	63.091	.....	282.102	.....
August	63.875	.....	65.260	.....	293.690	.....
September	66.535	.....	68.895	.....	306.273	.....
October	68.225	.....	70.245	.....	312.548	.....
November	68.667	.....	70.630	.....	309.284	.....
December	66.635	.....	68.514	.....	306.994	.....
Year	63.615	.....	65.285	.....	291.016	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1926	1927	1926 Spot	1926 3 Mos.	1927 Spot	1927 3 Mos.
January	8.304	6.661	38.059	37.363	30.979	30.938
February	7.759	6.673	36.053	35.956	29.931	30.109
March	7.332	6.692	34.090	34.247	30.649	30.889
April	7.001	6.338	32.503	32.863	29.579	29.901
May	6.821	.....	32.038	32.413	.....	.....
June	7.112	.....	33.244	33.398	.....	.....
July	7.411	.....	34.045	34.270	.....	.....
August	7.376	.....	34.173	34.524	.....	.....
September	7.413	.....	34.389	34.415	.....	.....
October	7.296	.....	34.256	34.146	.....	.....
November	7.199	.....	33.491	33.483	.....	.....
December	7.018	.....	32.915	32.895	.....	.....
Year	7.337	.....	34.105	34.164	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) Refined New York		Platinum (c) Crude New York	
	1926	1927	1926	1927	1926	1927	1926	1927
Jan.	23.490	13.910	87.960	101.200	118.200	109.520	113.200	99.820
Feb.	21.676	14.509	87.580	101.727	113.909	107.545	108.341	99.295
March	19.708	12.801	88.194	110.259	112.000	108.000	106.278	100.426
April	17.462	14.166	89.769	123.250	111.538	101.885	103.731	91.865
May	12.170	.....	91.365	.....	108.960	.....	102.900	.....
June	11.106	.....	91.346	.....	111.000	.....	106.615	.....
July	14.490	.....	90.163	.....	114.692	.....	109.000	.....
Aug.	15.957	.....	89.260	.....	116.000	.....	108.692	.....
Sept.	15.325	.....	91.425	.....	116.840	.....	108.600	.....
Oct.	13.943	.....	97.260	.....	112.240	.....	106.000	.....
Nov.	13.385	.....	99.000	.....	112.000	.....	105.250	.....
Dec.	13.142	.....	99.510	.....	111.846	.....	105.385	.....
Year	15.988	.....	91.903	.....	113.269	.....	106.999	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 75 lb. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1926	1927	1926	1927	1926	1927
January	22.76	21.40	21.76	20.01	22.26	20.26
February	22.76	20.76	21.76	19.76	22.26	20.26
March	22.76	21.15	21.76	20.33	22.26	20.26
April	21.38	21.26	20.66	20.49	21.05	20.26
May	21.12	.....	19.76	.....	20.76	.....
June	20.76	.....	19.76	.....	19.80	.....
July	20.44	.....	19.26	.....	19.49	.....
August	19.87	.....	19.18	.....	19.26	.....
September	20.11	.....	19.26	.....	19.30	.....
October	20.76	.....	19.76	.....	19.97	.....
November	21.90	.....	20.46	.....	20.96	.....
December	21.26	.....	20.26	.....	20.53	.....
Year	21.31	.....	20.29	.....	20.64	.....

In dollars per long ton.

Monthly Crude Copper Output in Short Tons

Domestic

	1926 Oct.	1926 Nov.	1926 Dec.	1927 Jan.	1927 Feb.	1927 March
Alaska shipments	3,073	3,769	2,372	2,981	2,696	3,163
Braden	8,000	10,200	9,235	8,756	8,022	.....
Chile	9,350	9,350	9,352	.....	.....	.....
Butte & Superior	.....	.....	†613	.....	.....	.....
Calumet & Arizona	2,380	1,833	1,951	1,864	1,500	2,704
Magma	1,198	1,155	1,148	1,264	1,120	1,308
Miami	2,468	2,412	2,268	2,313	2,160	2,342
New Cornelia	3,556	4,227	3,347	2,770	2,373	3,447
Nevada Con.	.....	.....	†31,316	.....	.....	.....
Old Dominion	908	1,127	1,120	1,170	1,162	986
Phelps Dodge	5,493	6,638	5,732	6,097	6,427	††7,789
United Verde Extension	1,901	1,677	1,586	1,703	1,152	1,322
Utah Copper	.....	.....	†32,557	.....	.....	.....
Tennessee Copper	523	524	486	486	408	458

Foreign

Boleo, Mexico	992	992	.....	863	885	973
Furukawa, Japan	1,431	1,668	1,502	1,456	1,249	.....
Granby Cons., Canada	1,623	1,626	*2,355	2,439	1,975	2,339
Union Miniere, Africa	6,525	7,260	7,150	6,505	6,273	6,976
Mount Lyell, Aust.	.....	.....	†1,870	.....	.....	†1,347
Sumitomo, Japan	.....	1,637	.....	1,408	1,347	.....
Bwana M'Kubwa	255	344	376	400	358	450

*Starting with December Allenby production is included. †Three months.
††Starting with March Moctezuma is included.

Monthly Production of Primary Copper from U. S. Mines and Daily Rate (Short Tons)

	1925 Monthly Production	1925 Daily Rate	1926 Monthly Production	1926 Daily Rate	1927 Monthly Production	1927 Daily Rate
January	74,789	2,412	71,026	2,291	76,198	2,458
February	68,967	2,463	68,131	2,433	69,202	2,472
March	74,901	2,416	75,728	2,443	68,881	2,222
April	70,667	2,356	73,454	2,448	.....	.....
May	70,574	2,276	73,542	2,372	.....	.....
June	59,894	2,330	71,317	2,377	.....	.....
July	68,507	2,210	72,278	2,330	.....	.....
August	68,090	2,196	72,014	2,323	.....	.....
September	67,720	2,272	72,672	2,421	.....	.....
October	71,042	2,292	75,099	2,423	.....	.....
November	67,400	2,247	74,947	2,498	.....	.....
December	69,566	2,244	72,205	2,329	.....	.....
Total	842,117	.....	872,509	.....	214,281	.....
Monthly average	70,176	.....	72,709	.....	71,427	.....
Average of daily rate	.....	2,307	.....	2,390	.....	2,381

Mining Stocks—Week Ended April 30, 1927

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	47⅞	45½	45⅝	Ap.16,May21 Q	0.75
Arcadian Consol.	Boston	*45	*42	*42		
Ariz. Com'l.	Boston	7	6⅜	6½	Ja. 7, Ja. 28	0.50
Calaveras	N. Y. Curb	2 1/16	2⅛	2⅛		
Calumet & Arizona	New York	68¼	65½	67	Ma. 5, Ma. 21Q	1.50
Calumet & Hecla	Boston	16¾	16⅜	16¼	My.31, Jn.15Q	0.50
Cerro de Pasco	New York	62⅝	59	60¼	Ap 14, My.2 Q	1.00
Chile Copper	New York	38	36⅜	37	Jn.3, Jn.30, Q	0.62½
Con. Coppermines	N. Y. Curb	3⅛	3	3		
Copper Range	Boston	13	12⅛	12½	Ap.2, My 2, A	1.00
Crystal Copper	Boston Curb	*34	*25	*31		
East Butte	Boston	2⅛	1½	1⅝	Dec., 1919	0.50
Granby Consol.	New York	40	37⅝	38⅛	May, 1919	1.25
Greene-Cananea	New York	45	41⅝	41⅞	Nov., 1920	0.50
Hancock	Boston			*32		
Howe Sound	New York	39½	37⅞	38⅛	Apr.1,Apr.15 Q	1.00
Inspiration Consl.	New York	19⅝	18⅛	18⅝	Ma.17, Ap.4,Q	0.25
Iron Cap	Boston Curb	2	1	1		
Isle Royale	Boston	10⅞	10⅛	10⅛	Fe.4, Fe.19 Q	0.50
Kennecott	New York	65⅞	63	63⅞	Mar. 4 Apr. 1 Q	1.25
Magma Copper	New York	34⅜	33⅜	34	Ma.31,Ap.15,Q	0.75
Mason Valley	N. Y. Curb	1⅝	1⅛	1⅜		
Miami Copper	New York	16⅛	15⅞	16	My.2,My.16 Q	0.37½
Mohawk	Boston	40⅜	38	38⅛	Ap 30, Jn 1 Q	1.00
Mother Lode Coa.	New York	4⅜	4⅛	4⅛	De.10, De.31SA	0.37½
Nevada Consol.	New York	14¾	14⅛	14⅜	Ma.17,Ma.31Q	0.37½
New Cornelia	Boston	22⅞	22¼	22⅜	My.6, My.23Q	0.50
Noranda	N. Y. Curb	22⅞	21	21		
North Butte	Boston	2⅜	1⅞	2⅛	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*55	*46	*50	Sept., 1926	0.03
Old Dominion	Boston	13	12⅞	12⅞	Dec., 1918	1.00
Phelps Dodge	N. Y. Curb	120½	115	115	Ma.22, Apr.2 Q	1.50
Quincy	Boston	18	15½	16½	Mar., 1926	1.00
Ray Consolidated	New York	15⅞	15⅝	15⅝	Ap.20, Ap 30	0.25
St. Mary's Min. Ld.	Boston	22	21⅛	21⅛	Fe.10 Ma.10	2.00
Seneca Copper	New York	2⅛	2	2⅛		
Shattuck-Denn	Boston Curb	5⅛	4⅛	4⅛		
Tenn. C. & C.	New York	12⅜	11⅛	11⅛	Fe.28, Ma.15, Q	0.25
United Verde Ex.	N. Y. Curb	24⅛	23⅛	24⅛	Apr.6, May1 Q	0.75
Utah Copper	New York	115	115	115	Ma.17,Ma.31Q	1.50
Utah Metal & T.	Boston	1⅜	1 1/16	1⅜	Dec., 1917	0.30
Walker Mining	Salt Lake	*52	*51	*51		
NICKEL-COPPER						
Internat. Nickel	New York	60⅜	55⅜	56	Ma.17,Ma.31Q	0.50
Internat. Nickel, pfd.	New York	...	...	105	Ap.14,My.2 Q	1.50
LEAD						
Gladstone Mtn.	Spokane	*24¾	*23½	*24	April, 1927	0 005
National Lead	New York	196	190⅜	192⅜	Jn..10,Jn 30 Q	1.25
National Lead pfd.	New York	130	129	129⅞	My.10,Jn.15Q	1.75
St. Joseph Lead	New York	40	39⅞	40	Se.10,Se.20, Q	X0.75
ZINC						
Am. Z. L. & S.	New York	8	7⅛	7⅝	May, 1917	1.00
Am. Z. L. & S, pfd.	New York	47	45⅞	46¾	Nov., 1920	1.50
Butte C. & Z.	New York	5	4	5	De.9, De.24	0.50
Butte & Superior	New York	9⅜	8⅛	8⅞	Ma.15, Ma.31Q	0.50
Callahan Zn-Ld	New York	1⅝	1⅜	1⅜	Dec., 1920	0.50
Consol. Lead&Zinc'A'	St. Louis	15	13	13	Ma.15, Ap.1 Q	0.25
Eagle-Picher	Cincinnati	27⅛	26⅜	26⅞	Au.15, Se.1 Q	0.40
Eagle-Picher, pfd.	Cincinnati	116	116	116	Jn.30, Jy.15 Q	1.50
New Jersey Zn.	N. Y. Curb	187	179½	180⅜	Ap 20,My.10 Q	2.00
United Zinc	N. Y. Curb	...	...	55		
Yellow Pine	Los Angeles	*25	*25	*25	Dec. 1925 Q	0.04
GOLD						
Alaska Juneau	New York	1⅛	1⅜	1⅜		
Argonaut	Toronto	*43	*42	*42¼		
Barry-Hollinger	Toronto	*47	*40	*41		
Carson Hill	Boston	*50	*50	*50		
Consol. W. Dome L.	Toronto	*8	*7	*7⅜		
Cresson Consol. G.	N. Y. Curb	2	2	2	Ma.31,Ap.10Q	0.10
Dome Mines	New York	9	8⅛	8⅛	Ap.18, My5,Q	0 25
Golden Cycle	Colo. Springs	†1 65	†1 63	...	Fe 28,Ma. 10 Q	0.04
Hollinger Consol.	Toronto	21 00	20 65	21 00	My.4, My.20	0.10
Homestake Mining	New York	61	61	61	Ap.20,Ap.25 M	0.50
Kirkland Lake	Toronto	1.42	1.05	1.42		
Lake Shore	Toronto	19 14	18 85	19 05	Ma.1, Ma.15	0 10
McIntyre-Porcupine	New York	25⅞	25⅛	25⅛	My.2, Jn.1 Q	0 25
Portland	Colo Springs	†*48	†*46	...	Ap.6, Ap.15, Q	0.02
Rand Mines	New York	...	...	9⅛	Au.23-30Am.Sh.	1.52
Teck-Hughes	Toronto	7.05	6 90	7 00	Ja.31, Fe. 1	0.05
Tom Reed	Los Angeles	*40	*40	*40	Dec., 1926	0.02
Tough-Oakes	Toronto	*53	*50½	*51½		
United Eastern	N. Y. Curb	...	...	*44	July, 1924	0.05
Vipond Cons.	Toronto	1.42	1 15	1.22	Apr.1 Apr.15	0.03
Wright-Hargreaves	Toronto	11.15	10.90	11.03	Ap.15,My.2	0.10
GOLD AND SILVER						
Carnegie Metals	Pittsburgh	12⅜	12⅞	12⅝		
Con. Cortez	N. Y. Curb	*24	*21	*21		
Con. Virginia	San Francisco	*4½	*4⅜	*4⅜		
Dolores Esperanza	N. Y. Curb	...	...	*45	July, 1923	0.05
Premier Gold	N. Y. Curb	2 1/16	2 1/16	2 1/16	Ma.15, Ap.4Q	0.08
Tonopah Belmont	N. Y. Curb	1⅞	1⅝	1⅝	Ma.15, Ap.4	0.08
Tonopah Extension	N. Y. Curb	*27	*26	*26	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	2⅜	2⅜	2⅜	Ma.31, Apr.21	0.07½
West End Consol.	N. Y. Curb	*10	*10	*10	Mar., 1923	0.05
Yukon Gold	N. Y. Curb	...	...	*45	June, 1918	0 02
SILVER						
Beaver Consol.	Toronto	1.08	*84	1.07	May. 1926	0.03
Canadian Lorrain	Toronto	*28	*26½	*26½		
Castle-Trethewey	Toronto	*97	*93	*93		
Coniagas	Toronto	3.92	3.65	3 92	May, 1924	0.12½
Keeley	Toronto	1.40	1 24	1 35	Fe.28, Ma.15	X 0.12
Lorrain Trout Lake	Toronto	*30	*30	*30	July, 1925	0.05
McKinley-Dar.-Sav.	Toronto	*16	*15	*15	Oct., 1920	0 03

Stock	Exch.	High	Low	Last		Last Div.
SILVER—(Continued)						
Mining Corp. Can.	Toronto	3.55	3.40	3.45	De.30, Ja.15	0.12½
Nipissing	N. Y. Curb	7⅛	5	6⅜	Ma.31, Ap.20 Q	0.15
SILVER-LEAD						
Ahumada	New York	4	3⅝	4	Ma 25,Ap.4,Q	X 0.12½
Bingham Mines	Boston	47	45½	46	Ma.21, Ap.5 Q	1.00
Bunker Hill&Sullivan	N. Y. Curb	76⅝	75	75½	Ma.31,Ap.4MX	0.75
Cardiff M. & M.	Salt Lake	*58	*50	*58	Feb. 5, 1927	0.10
Chief Consol.	Salt Lake	2.42½	2.37½	2.37½	Oc.10, No.1 Q	0 10
Consti'n Mng.&Mill'g	Spokane	*29	*26	*28		
Erupcion	Boston Curb	*55	*50	*52	Ma.25, Ap.2 Q	0 07½
Eureka Lily	Salt Lake	1.40	1.32½	1.40		
Federal M. & S.	New York	...	...	112		
Federal M. & S., pfd.	New York	94	94	94	Fe.24, Ma.15 Q	1.75
Hawthorne Mines	N. Y. Curb	*4	*3	*4		
Hecla Mining	N. Y. Curb	13½	13½	13½	Fe.15,Ma.15 Q	0.25
Highland-Surprise	Spokane	*8	*7½	*7½		
Iron King Mining	Salt Lake	*36	*35	*35		
Keystone Mining	Salt Lake	*30	*30	*30	Au.12, Au.26	0.07½
Lucky Jim	Spokane	*20½	*19	*20½		
Lucky Tiger-Com.	Kansas City	†7.00	†6 75	....	Ap.20, 1927 M	0.05
Mammoth Mining	Salt Lake	1.90	1.90	1.90	De.17, De.23,Q	0.25
Marsh Mines	Spokane	2.00	1.75	1.75		
North Lily	Salt Lake	2.95	2.75	2.80		
Park Utah	New York	6⅞	6⅜	6⅜	Ma.15, Ap.1 Q	0.20
Plutus Mining	Salt Lake	1.80	1.75	1.75	Ja.10, Ja.15 Q	0.10
San Rafael	San Francisco	...	...	*24		
Silver King Coal.	Salt Lake	7.80	7.75	7.75	Ma.21, Ap.1 Q	0.25
Silversmith	Spokane	*33	*32	*33	Oc.1, Oc.10 Q	0.02
Strattons Mines	Spokane	*45	*43½	*43½		
Sunshine M. Co.	Spokane	*67	*60	*60		
Tamarack-Custer	Spokane	*30½	*29	*29	Sept., 1924	0.25
Tintic Standard	Salt Lake	10.87½	10.75	10 87½	Ma.16, Ma.29X	0.40
Utah-Apex	Boston	6	5⅝	5⅞	Oct., 1926	0.25
IRON						
Bethlehem Steel	New York	51⅜	48¼	48⅞	July, 1924	1.25
Cleveland-Cliffs Iron	Cleveland	78	75	77⅜	Ja.15, Ja.25 Q	1.00
Colorado Fuel & Iron	New York	82⅜	76⅞	79	May, 1921	0.75
Gt. North'n Iron Ore	New York	86	85⅜	86	Dec.6, Dec.28	0.75
Inland Steel	New York	44	42¼	42⅜	My. 13, Jn.1 Q	0.62½
Replogle Steel	New York	10	9⅛	9⅛		
Republic I. & S.	New York	66½	62½	64⅛	My.14 Jn. 1 Q	1.00
Republic I. & S. pfd.	New York	104	103½	103¾	Jn 14, Jy.1 Q	1.75
Sloss-Sheffield S. & I.	New York	126½	124	125	Ma 10, Ma.21 Q	1 50
Sloss-Shef. S.&I. pfd.	New York	106	106	106	Ma 21, Ap.1 Q	1.75
U. S. Steel	New York	172⅜	165½	165⅞	Jn 7, Jn.29 Q	1.75
U. S. Steel pfd	New York	124⅜	119	119	My.2,My.28, Q	1 75
Virginia I. C. & C.	New York	50	49	50	Jan., 1924	1.50
Virginia I.C.&C.pfd.	New York	...	...	60½	De.15, Ja.2,	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN						
De Beers Consol.	New York	30⅞	30⅛	30⅛	Ja.26, Ja.29	1.45
So. Am. Gold & P.	N. Y. Curb	3⅛	3⅛	3⅛		
Alum.Co.of Amer.	N.Y.Curb	...	...	70		
Alum. Co. of Amer pf.	N.Y.Curb	102⅞	102⅞	102⅞	Ma.15,Ap.1 Q	1.50
Vanadium Corp.	New York	48¼	46⅛	47⅛	My.2, My.16Q	0 75
Patino M. & E.	New York	23⅛	22	23	Ap.27, My.5	1 sh.
ASBESTOS						
Asbestos Corp.	Montreal	22⅝	22	22⅛	Jan., 1926	1.50
Asbestos Corp., pfd.	Montreal	87⅛	85⅞	87⅝	Ma.31,Ap.15 Q	1.75
SULPHUR						
Freeport Texas	New York	65⅛	61	63⅜	Ap.15, My 2 Q	1.00
Texas Gulf, new	New York	62⅝	57⅛	60⅛	Ma.1, Ma.15Q	1.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	43	41⅛	41⅛	My 20,Ju. 1 Q	0.75
Amer. Metal pfd.	New York	110	110	110	My 21, Ju.1 Q	1 75
Amer. Sm. & Ref.	New York	150¼	145	145½	Ap.14, My.2 Q	2.00
Amer. Sm.&Ref.pfd.	New York	126	126	126	My.6, Jn 1 Q	1 75
Consol. M. & S.	Montreal	256	250	255	De.31, Ja.15 X	6 25
Federated Metals	N. Y. Curb	12	12	12		
Newmont Mining	N. Y. Curb	75⅛	74	74⅛	Ma.31 Ap 15 Q	0 60
U. S. Sm. R. & M.	New York	38	37⅛	37⅛	Ap.7 Ap.15 Q	0 87½
U. S. Sm. R.&M.pfd.	New York	48⅜	47⅜	48	Ap.7, Ap. 15, Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. F, four weeks. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

LONDON QUOTATIONS—WEEK ENDED APRIL 19, 1927

Name	High	Low	Last	Date	Amount	Last Div.
Aramayo Mines (25 frs.)	86/10½	83/9	85/—	Feb. 1927	5 (†)	
British Platinum (£1)	4/—	3/9	4/—	Feb. 1925	2½ p.c.	
Burma Corpn. (10 rupees)	14/1½	13/10½	14/—	Feb. 1927	6 annas*	
Bwana M'Kubwa (5s)	6/3	6/—	6/3			
Camp Bird (2s)	4/9	4/7½	4/9			
El Oro (£1)	4/6	4/—	4/3	Nov. 1924	2½ p.c.*	
Esperanza (10s)	—/2	—/2	— 2			
Frontino & Bolivia (£1)	12/6	12/—	12/6	Jan. 1927	5 p.c.	
Mexican Corpn. (£1)	9/6	9/3	9/3			
Mexico Mines of El Oro (£1)	16/3	15/1½	16/3	Dec. 1926	3¾ p.c.*	
N'Changa Copper Mining	11/3	10/—	11/—			
Oroville Dredging (£1)	6/9	6/6	6/9	Dec. 1923	3¾ p.c.	
Ouro Preto (£1)	4/6	4/3	4/6	May 1925	2½ p.c.	
Rhodesian Congo Border (£1)	58/9	55/7½	57/6			
St. John del Rey (£1)	12/6	11/3	12/6	May 1927	3¾ p.c.	
San Francisco Mines (10s)	32/9	31/9	32/—	Jan. 1927	2½s.	
Santa Gertrudis (£1)	15/3	15/—	15/3	Jan. 1927	3¾ p.c.	
Selukwe (2s. 6d.)	10/4½	10/—	10/—	April 1917	6¼ p.c.	
S. Amer. Copper (2s.)	3/3	3/—	3/—	Nov. 1917	75 p.c.	
Tanganyika (£1)	62/4½	50/7½	51/3	Aug. 1926	7½ p.c.	
Union Miniere du Haut-Katanga (Brussels)	9.085	9.060	9 085	July 1926	175 (‡)	

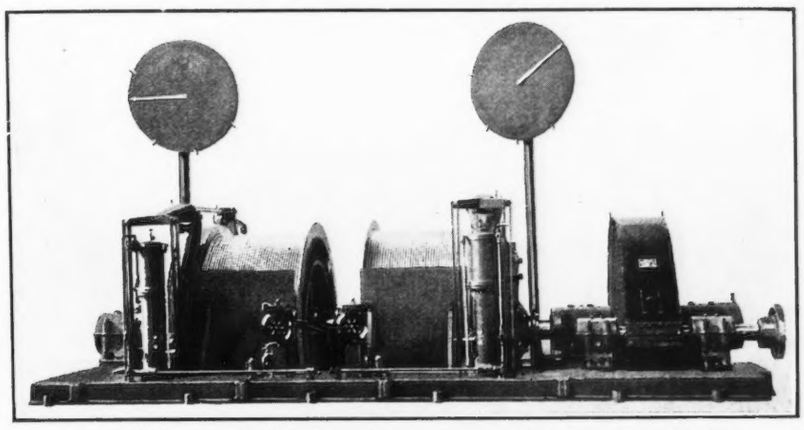
* Free of British income tax. † Swiss frs. ‡ Belgian frs. and free of taxation.

New Machinery and Inventions

Horne Copper Installs New Electric Hoist

First in the Rouyn District—Has Most Modern Safety Devices

By H. V. Haight
Chief Engineer, Canadian Ingersoll-Rand Co.

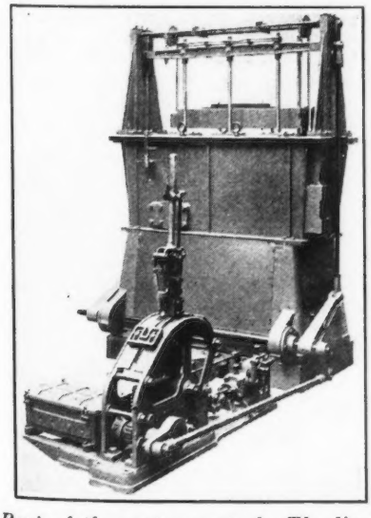


Noranda's new double-drum hoist, as erected in the maker's shops

THE Horne Copper Corporation (controlled by Noranda Mines) has installed the first electric hoist in the Rouyn district, in Quebec. The hoist is of the double-drum type, for balanced hoisting, and is shown, as erected in the maker's shops, in one of the accompanying illustrations. The principal dimensions, speeds and capacities are:

Diameter and face of each drum	96 by 48 in.
Capacity (maximum pull on one rope)	20,000 lb.
Diameter of hoisting rope	1¾ in.
Rope capacity, each drum	3,000 ft.
Electrical conditions,	550 volts, 25 cycles, 3 phase

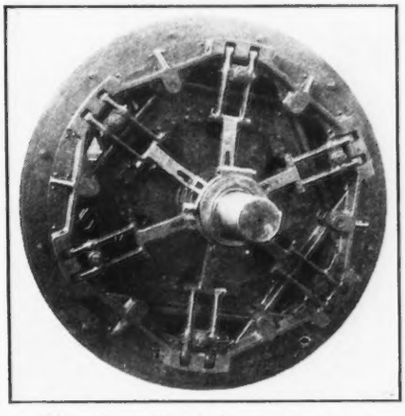
	Present	Ultimate
Depth of shaft	600 ft.	1,200 ft.
Hoisting speed, feet per minute	750	1,500
Motor horsepower	250	450



Part of the motor control—The liquid rotor regulator

The increase in the hoisting speed will be made by using a motor of higher speed, the gearing requiring no change.

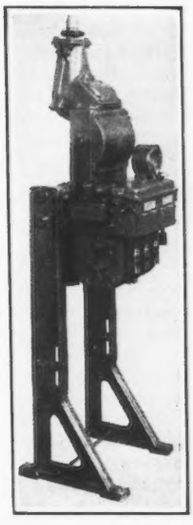
On account of having several classes of ore to hoist, as well as waste, it is considered impracticable to use skips. Instead three-ton cars will be used. The calculated maximum dead load on each rope is as follows: Ore, 6,000 lb.; car, 2,200 lb.; cage, 6,000 lb.; and rope (1,200 ft. 1¾ in.), 2,500 lb. Total load will be 16,700 lb.



The plate clutch has advantages over the jaw clutch

The hoist is driven through single-reduction cut-steel herringbone gear, running in an oil-tight sheet-steel case. Both gear and pinion are supported by bearings close on each side, giving the rigid mounting essential for smooth-running gears. This construction provides four bearings on the drum shaft. Connection with the motor supplying power for the hoist is made with a Francke flexible coupling.

The drums have steel-plate barrels, bolted to cast end flanges. The drum barrels are spirally grooved to guide the ropes. Each drum has provision for clamping the end of the rope, consisting of an auxiliary rope path and two clamps. This makes a strong, safe anchorage and yet permits the rope to be changed easily and quickly. The drums and everything else which goes on the main shaft, except the gear, are in halves, for convenience in assembly.



At right, circuit breaker and disconnecting switch

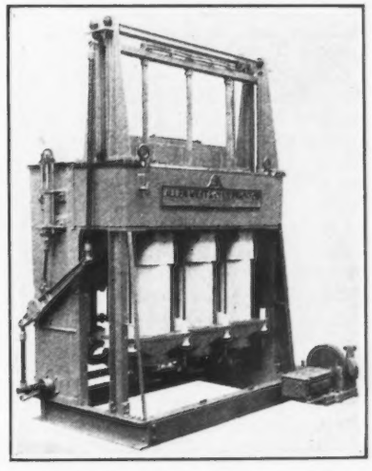
Both drums are driven through plate clutches of the type shown. As compared with any type of jaw clutch, this plate clutch permits more accurate adjustment of the relative position of the two cages; engages more quickly and quietly; and can be used to stop a runaway drum. Compared to a band clutch, it has large friction surfaces, rendering it powerful though of reasonable size; it is symmetrical in design and is thus in perfect running balance, and it is safe, there being six arms which engage it.

Each clutch is operated by an air engine. The clutch engines are operated by valves under the platform, which are controlled by levers extending above the platform.

Each lever is interlocked with the brake lever on the same drum, so that both clutch and brake cannot be disengaged at the same time.

The bearings are of the ring-oiling type with renewable babbitt-lined sleeves. There is a large oil reservoir in the base of each bearing. The bearing at the right-hand end of the drum shaft also includes a thrust bearing for preventing end movement of the shaft.

The main brakes are of the post type. The posts are supported on parallel motions front and back. The parallel motion links are adjustable to get equal clearance of the brakes top



Another view of the liquid rotor regulator

and bottom, and have set screws to give equal clearance front and back. Equalizing levers and rods provide for equal pressure all around when the brakes are set. Brake posts are reinforced with steel tension rods. The brake lining is of basswood blocks.

The brakes are set by weights and released by an air engine. This engine is controlled by a double poppet valve through floating gear connected to a lever on the operating platform. The gear controls the brake engine so that the weights follow accurately the motion of the hand lever, giving the operator close control of the braking. An indicator is provided to show when the brakes need adjusting to take up wear.

The indicators are gear-driven and have 60-in. dials. Their position deserves note. Usually indicators are in front of the drums, or above them. In the first case they hide the view of the ropes winding on the drum, and in the second case they hide the view of the ropes entering the hoist house. With the indicators located as shown on page 791, there is a clear view of the rope at all times.

The hoist is completely equipped with safety devices. The two Lilly controllers are shown in detail in the photographs on the preceding page. Each has two limit cams for top and bottom of the travel of cage; also a retarding cam to insure slowing down when approaching the top landing; an overspeed governor, a warning gong, and an alarm bell. As further precaution there is a track limit switch in each compartment of the shaft.

These devices are designed to prevent overspeeding, overwinding, approaching the landing at too high speed, or starting in the wrong direction. If any of these things should happen the hoist would be shut down through the opening of the circuit breaker and the application of the brake. In case of overwinding, the safety circuit is restored by a back-out switch, which also prevents going further in the wrong direction. An emergency switch enables the operator to open the same safety circuit and make an emergency stop.

In the case of an emergency stop, the brake regulator, shown on the side of the Lilly controller, causes the brakes to be set slowly if the cage is traveling at high speed, but quickly if the cage is traveling slowly near the limit of its travel.

The motor control was furnished by Allen West & Co., Ltd., of Brighton, England. The circuit breaker and disconnecting switch are totally inclosed and are interlocked in such a way that the disconnecting switch cannot be opened unless the circuit has been broken by the circuit breaker. Also, the case of the circuit breaker cannot be opened for examination unless the disconnecting switch is open.

In the liquid rotor regulator there are three fixed electrodes, one in the bottom of each porcelain pot. The three moving electrodes are lowered into the electrolyte to cut out the rotor resistance and bring the motor up to speed. This gives a smooth acceleration. The accelerating period may be controlled by an oil cylinder on the side.

The hand lever for controlling the moving electrodes has compressed-air-assisted gear, giving easy control. The hand lever also operates the master switch, shown in the lower-right-hand corner of the illustration, which in turn controls the primary contactors. The latter are of the totally inclosed type.

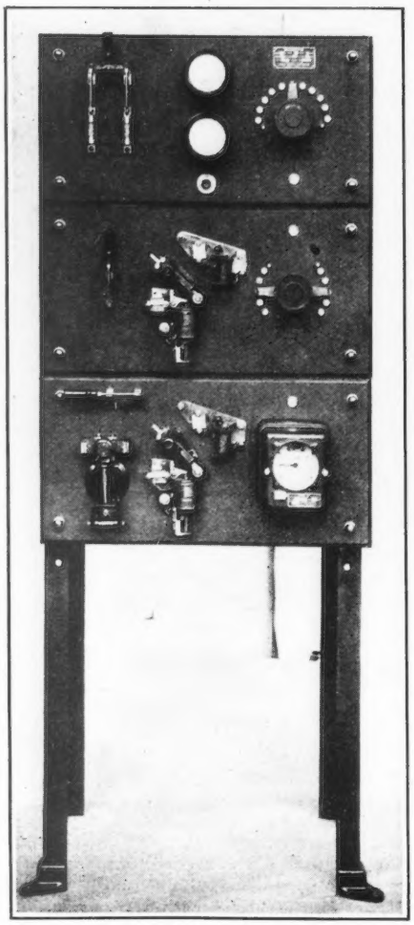
The motor was built by Canadian Westinghouse Co., Ltd., at Hamilton, Ont. The complete hoist with electrical equipment was furnished by the Canadian Ingersoll-Rand Co., Ltd., the hoist itself being designed and built at the company's shops at Sherbrooke, Que.

Battery Charging Device Is Self-Contained

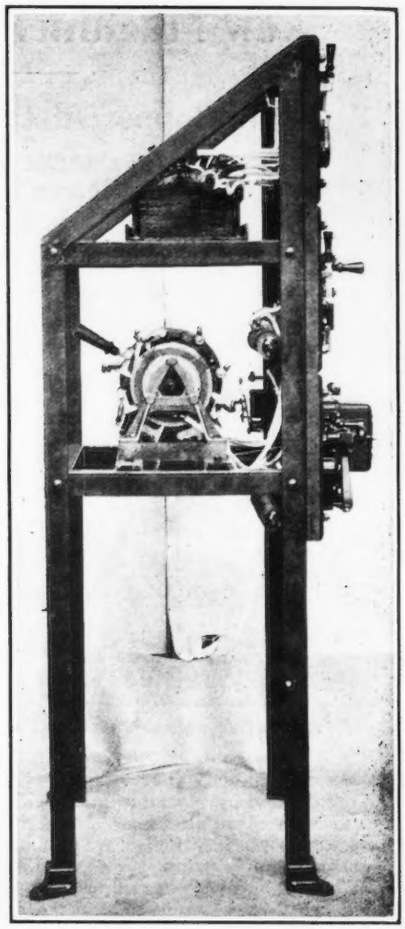
Marking a change in the design of units for charging storage batteries the Liberty Electric Co., Stamford, Conn., announces the Syncroverter. This device is a commutating rectifier, the commutator being driven by a patented synchronous motor that has been developed and which, it is claimed, is in phase at all times and is non-hunting.

Commutators are of the construction standard to this class of equipment. The alternating current is taken in through slip rings on the side of the commutator, rectified and taken off by the radial brushes as pulsating direct current.

These charging units may be automatically operated, using an ampere-hour meter, which may be mounted either on the locomotive or the charging panel. The Syncroverter is equipped with reverse-current protection, overload protection, independent fully charged cut-off for each battery, and an automatic stop which comes into operation when the last battery has been fully charged.



Front view of charging unit



Side view of charging unit

An Improved Fire Signal

A new siren for use as a fire alarm in factories, mines, and warehouses has been announced by the Federal Electric Co., 8700 South State St., Chicago, Ill. This is known as the "Triple-A" siren. It consists of three sirens mounted on a triangular base. These are connected in parallel and operate from one push-button switch. Each has approximately ⅓ hp., the total being 1 hp. The tone of each of the sirens is different, giving a pleasing combination. With a siren mounted on each angle of the triangular base, the alarm signal penetrates in every direction and has a sound radius of from three-eighths to a half mile under normal conditions.

Catalogs

Grinding Mills—The Hardinge Co., York, Pa. Conical rod mill. Bulletin No. 25, 8 pages.

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